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BASIC PRINCIPLES AND SUPREME DIFFICULTIES IN GASTRIC SURGERY[1]

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IN gastric surgery supreme difficulties occur, exciting situations arise, interesting physiological and pathological problems have to be solved at a moment's notice. The physiology of the stomach, worked out mostly on the lower animal, is perhaps not quite applicable to man. The causation of ulcer is still uncertain. As a consequence of these facts, the gastric surgeon, in the course of his daily work, must be competent to carry out a research on the living, and to be the final arbiter of the value of physiological principles, and by shrewd observations, establish others.

As the surgeon's life progresses, some of the apparently insoluble problems clarify from the wisdom which experience brings, and a routine is established for that particular surgeon, which he finds will ensure, for his patients, satisfactory results. It is along these lines that this contribution of personal experience is made, in the hope that these individual labors and views may suggest some fresh angle of vision.

This paper is founded on 1,000 carefully kept records of private cases of dyspepsia, characterized by pain after food and due to innocent causes; these might be grouped as follows:

Group (*A*) consisted of 250 cases, with definite, consistent symptoms and signs, and were cases of gastric duodenal ulcer.

Group (*B*) comprised the remainder, and these were in my opinion due directly or indirectly to a disturbance of the gastric or duodenal neuromuscular mechanism. Six cases of duodenal ileus obviously not due to mechanical pressure of the superior mesenteric artery, came under this heading.

After eliminating a large group of cases in which the condition was due to reflex abdominal disease, there still remained a small group of most troublesome cases in which no cause could be found. The dyspepsia was indistinguishable, except by X-ray, from that of gastric or duodenal ulcer, and even with X-ray examination and abdominal exploration could not be differentiated from the small ulcer which gave very little internal and no external gastric manifestation. Six of these small ulcers were found, but only by gastrotomy or by the use of an endoscope, which latter has a limited value (Figs. 1 and 3).

The fact that these patients did not get better after an exploratory operation and the removal of reflex causes, and that they were occasionally subject to gastrostaxis, was unpleasant for the surgeon and unfortunate for the patient. These cases might be subdivided as follows:

Subgroup (*a*), in which a small irritable, spastic stomach was found. This was associated with hyperacidity and a rapid emptying time. These cases were often in men with anxious occupation.

Subgroup (*b*), in which a large, air-filled, hypotonic stomach, easily deliverable, was

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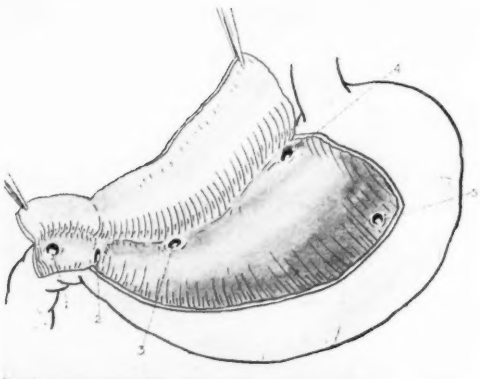

Fig. 1. Hidden ulcer situated on the (1) posterior duodenal wall, (2) posterior wall of pyloric muscle; (3) and (4) are ulcers of the gastric canal hidden under the attachment of the gastrohepatic omentum; (5) posterior wall fundus of stomach.

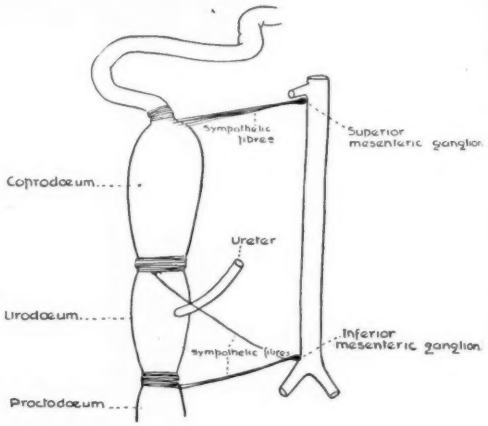

Fig. 2. Alimentary canal of young crocodile. (Gaskell.)

present. There was delayed emptying, and possibly from the dilution by retained contents, a hypo- or ortho-acidity. The mucous membrane (endoscopic examination, Fig. 3) and the peritoneum of the pars pylorica exhibited signs of irritation. Probably this was the result of the action of a high, or a prolonged low, acidity. These observations would confirm those of Hurst (12).

A POSSIBLE PRE-ULCER CONDITION

Two of these cases, with very prolonged and pronounced symptoms, came to autopsy from other causes, and no "hidden" ulcer was found. Three of this type of case, in my own clinic, after the possibility of a small, hidden ulcer was eliminated by operation and inspection of the interior of the stomach, eventually developed ulcer. Again, a great number of ulcer patients have had a previous negative operation for supposed ulcer. It has therefore occurred to me that this painful, spastic type of dyspepsia may be a pre-ulcer pathology.

POSTURE OF GASTRIC MUSCLE

From the work of Sherrington and the observations of Hunter (11) on the lower bowel when the sympathetic was divided, it may be presumed that there is a posture of gastric muscle in the sense of that word as employed by Sherrington. It corresponds to the plastic tone of voluntary muscle and is the degree of dilatation necessary to include the gastric contents when the muscle is at rest.

In the involuntary muscle of the colon and bladder, we (11) are now in a position to say that the sympathetic, which acts continuously, imposes a posture, the object of which is to retain material in the viscus for a purpose. This is accomplished by tonic contraction below and active dilatation of the visceral wall above. The function of the parasympathetic, which acts intermittently, is to empty the viscus. The two nerve systems are complementary and not balanced, and are in keeping with a general plan of double innervation common to the body. In the alimentary canal of the young crocodile (Gaskell) the bladder is in series with the rest of the alimentary canal (Fig. 2). It would then be unreasonable to suppose that the stomach is an exception to the rule and it is therefore possible and probable that disturbances of this retention posture, as a result of sympathetic influences, emanating from the strain of modern life, may be the primary alteration of normal physiology—the basis of ulcer. Subgroup (a) would then correspond to an increased function of the sympathetic and to the condition often found associated with gastric ulcer, and subgroup (b) would correspond to a diminished function of the sympathetic or an overacting vagus, and to the

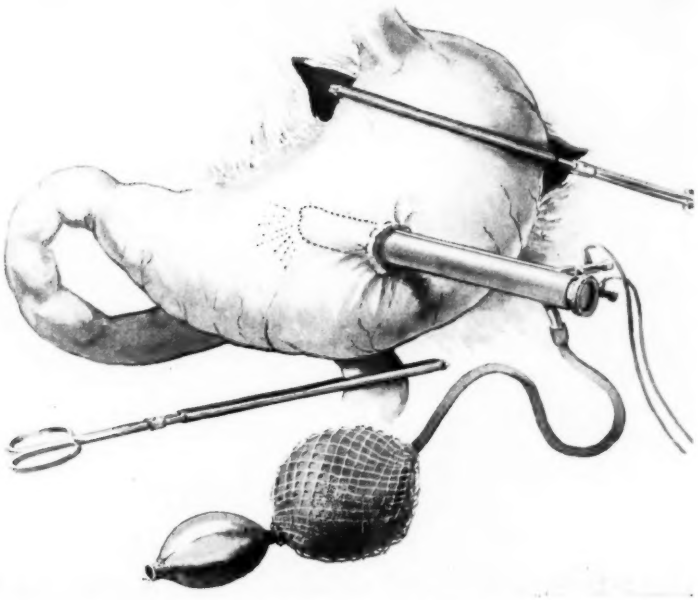

Fig. 3. Endoscopic examination of stomach used in conjunction with an electric suction pump.

pathology associated with duodenal ulcer. In the latter condition the duodenum would be exposed to any injury likely to result from the action of the gastric acidity while the stomach would suffer in the former.

THE NATURAL IMMUNITY OF THE STOMACH TO ACID AND AUTODIGESTION

The eroding action of normal gastric juice is seen on a gastrostomy wound, and yet the gastric mucosa is, according to recent experimental work, no more resistant to acid than any of the other tissues of the body. Tissues implanted into the stomach will not be digested if their circulation is intact (7 and 8). The gastric wall has therefore no specific natural immunity to its own acid.

We know from clinical experience that successful gastric surgery depends on the ability to control the acid, that ulcers occur only where there is acid and in recognized regions where its incidence is greatest. It is also a clinical fact that jejunal ulcer occurs mostly in association with hyper-acidity and always in the line of the projection of the acid whether in a modified Pólya (Fig. 4), or a gastroenterostomy (Fig. 5). Prolongation of ortho- or sub-acidity is equivalent in effect to short exposure with hyper-acidity. It is inconceivable that an infection should always be present in this same spot, and improbable that gastric should differ in its basic cause from jejunal and duodenal ulcer.

NATURAL ALKALINE REGURGITATION

Bolton and Goodhart (5, 6, 10) have shown that the concentration of acid in the stomach depends on a natural regurgitation of alkaline juices from the duodenum toward the end of the gastric stage of digestion. The extent of this no doubt must depend on the contractile tone and posture of the gastric and duodenal musculature. In man the acid is therefore probably controlled by the pylorus, and not the reverse, as is usually taught. The fact that water will open the sphincter of the pylorus at once in the presence of food, and actual estimations of acid in the vicinity of the

Fig. 4. Situation of jejunal ulcer in modified Pôlya operation. (1) Prepyloric part of stomach; (2) jejunal and gastric ulcers at the cardiac angle of the anastomosis; (3) jejunum; (4) colon; (5) duodenum.

sphincter, and X-ray observations, nullify the theory of acid control of the pylorus in man. The mechanism of the passage of food in the stomach, and urine in the bladder, of the young crocodile (Fig. 2) is probably not much different. Presumably normal content is all that is necessary in each case, and the regurgitation is probably only an anti- or retroperistaltic effect.

THE EFFECT OF ACID ON GASTRIC MUCOSA

Acid acts probably as a protoplasmic poison in the amœba and sea anemone and appears to be used for killing the live morsel; subsequent digestion is alkaline (Bayliss, 3).

Matthes (15) believes, from his experiments, that hyperacidity first injures the cell, then autodigestion of the injured cell follows.

Early experiments of feeding acid, which discredited the acid theory of ulcer, did not take into account the natural alkaline regurgitation, which, if allowed to function, would render the action of acid harmless. Where the pancreatic duct is ligated or the duodenal contents diverted into the lower intestine, experimental chronic ulcers have readily and consistently been obtained. (Mann and Williamson, 14.) This experimental fact might be compared with the clinical observation that jejunal ulcer is much more likely to occur after an anterior, or a long loop, or a Y gastro-enterostomy, or after a pyloric occlusion. The pancreatic alkaline regurgitation is diverted in the Y, minimized in the long loop by less secretin stimulation, and very much lessened by the loss of active duodenal peristalsis from loss of stimulative content in the occlusion.

The distribution of muscle supplied by the sympathetic varies in different species (Gaskell, 9) and probably in different individuals; the sympathetic takes the strain of reproduc-

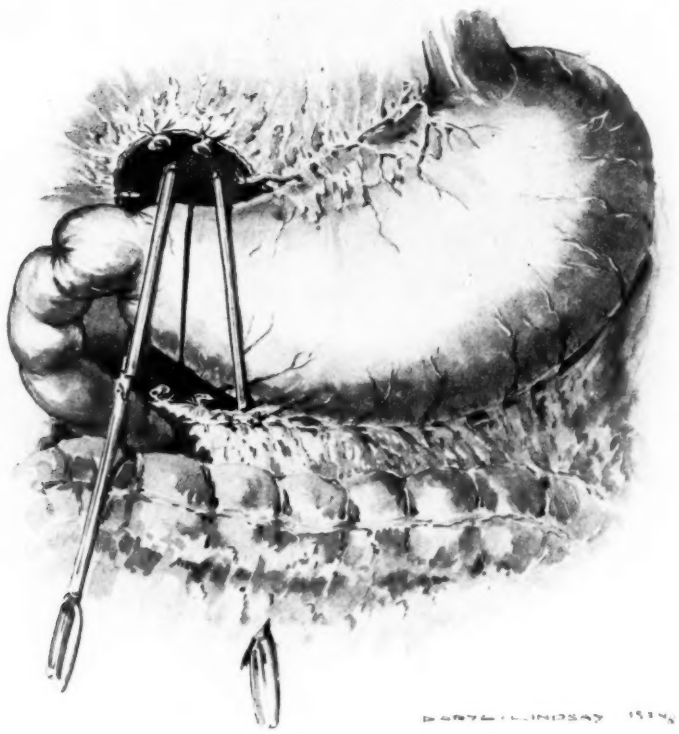

Fig. 6. Section of stomach in modified Pólya operation for duodenal ulcer.

tion and stresses of modern life; and as it is also probably subject to psychic influences, the posture of the gastric muscle is likely to vary a great deal.

The conception that abnormal development, irritability or disease of the "notoriously labile" sympathetic system can alter the postural tone of the gastric and duodenal muscle, the emptying of the stomach, the natural protective regurgitation, and the concentration of acid, is most probable and reasonable and explains many obscure clinical phenomena.

FAILURE OF NATURAL REGURGITATION

A breakdown of the orderly natural regurgitation, to which the stomach owes its local immunity from autodigestion and acid erosion, by an error in the involuntary nervous system, followed by disturbances of

Fig. 5. *A*. An X-ray diagram to show the current (arrows) of chyme in modified Pólya. *B*. Jejunal ulcer in usual position at cardiac angle while a silk thread was present at pyloric angle without an ulcer.

Fig. 7.

motility, could expose either the stomach or duodenum to a pernicious acidity. Acid is probably the influential factor in the causation of a certain type of jejunal and duodenal ulcer. Circulatory, toxic, and infective factors are essential for the origination of ulcer in association with low acid as in gastric and certain kinds of duodenal ulcer. There are probably two types of chronic ulcer; one in which there is a high acid and a good local resistance, the other in which the local lowered resistance is the determining cause. The principles of treatment will therefore depend on the individual case.

The appreciation and treatment of these neuromuscular painful dyspepsias constitute a problem in gastric surgery that has received scant attention. These patients are referred to the surgeon because of their intractability to treatment, in the hope that reflex or organic disease may be causing the dyspepsia.

THE POSSIBILITIES OF SURGICAL RELIEF

Up to the present this subject has been regarded as outside the province of the surgeon. Resection of the pyloric sphincter in a few cases gave only a temporary, or doubtful, benefit. Section of the sympathetic to the large bowel in the spinal animal caused immediate contractions and defecation took place under sight and (10) when the lumbar rami of the sympathetic were cut in a paraplegic, an obstinate constipation was at once cured (Royle, 19). Division of the funiculus marginalis sympathetic in the stomach in the dog, halves the emptying time and doubles its peristaltic action. In the light of this knowledge, and since the innervation for different parts of the alimentary canal must follow the general plan, I destroyed sympathetic fibers to the distal third in two cases with delayed emptying time. This increased the emptying time, but caused an annoying sense of distention after food.

Many of the sympathetic subgroup had frequent, often large hæmorrhages, with pain after food, for years, and were really serious and anxious cases. Feeling that it was unkind to wait any longer for some of these

Fig. 9. Division of stomach for partial gastric exclusion.

sufferers to get better, I removed, in three cases, the sympathetic inhibitory area and reduced the size of the stomach by a partial gastrectomy with most gratifying results. It is unwise to resect too much of the stomach in these cases, as a very rapid emptying into a hypotonic intestine might give a feeling of "seasickness" after meals. I have done these operations only on the few intractable cases, but I wonder if some temperate and well-chosen surgery might not be better for some of these derelicts than a life of misery and inefficiency.

INVOLUNTARY NERVOUS SYSTEM A FACTOR IN FORMATION OF ULCER

It would appear, therefore, that duodenal ulcer might result from an autonomic and gastric ulcer from sympathetic influence, and that this should be taken into account when principles governing their treatment are formulated. Two factors should be considered in both gastric and duodenal ulcer.

1. The set of circumstances neuromuscular, secretory, and infective in origin that caused the ulcer and will cause a recurrence unless remedied, must be considered—the ulcer was

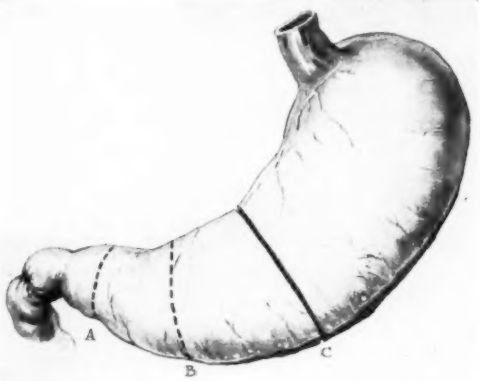

Fig. 8. Sections of stomach at different levels in partial gastric exclusion. A, B, C.

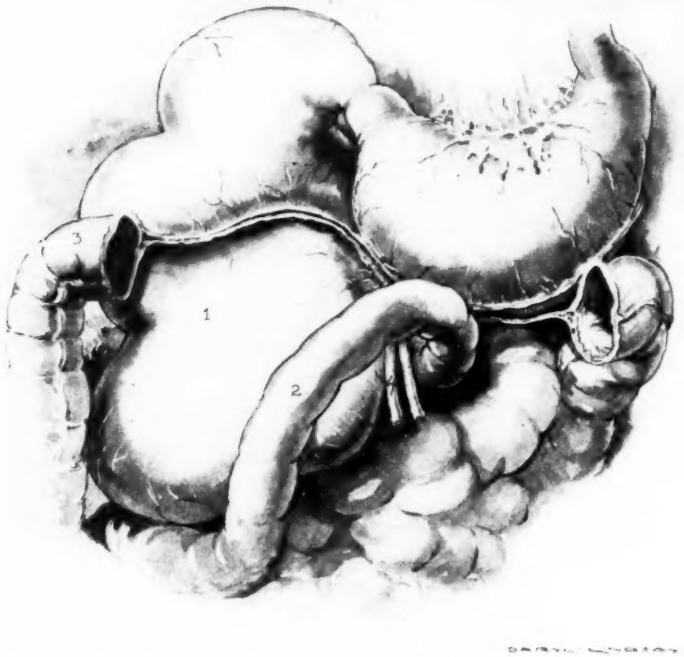

Fig. 11. Case of duodenal ileus twelve months after duodenojejunostomy. (9) Duodenum is just as dilated after operation. (2) Anastomosis between jejunum and dilated duodenum. (3) Colon. Superior mesenteric artery.

not an accident. The acid secretion is probably the offending, but a controllable factor.

2. The secondarily infected callous ulcer which could be cured only by resection in a mucous membrane free from the influence of acid, as for example, ulcer of the rectum.

In the acid type of duodenal ulcer, then, with its hypermotility and hyperacidity, the essential of the surgical therapy must be an alkalizing operation. The ulcer was very likely to recur after resections of even small duodenal ulcer, without this procedure. Resection of ulcer with gastro-enterostomy or pyloroplasty has given me good results in the small type of duodenal ulcer on the anterior wall in 75 per cent of the cases.

OPERATION FOR CALLOUS ULCER OF POSTERIOR WALL OF THE DUODENUM

The choice of operation for old callous ulcer on the posterior wall of the duodenum was indeed a great difficulty. Recurrence of this ulcer was frequent when gastro-enterostomy was done. Resection of such an ulcer was always difficult and dangerous. Hoping to obtain more permanent results in this class of case, I have employed, since 1916, a Pólya operation, without any resection of stomach (Figs. 4, 6, and 7) in 30 cases. I thought the size and situation of the stoma would ensure adequate alkaline regurgitation and a more natural emptying time, while the ulcer would be closed off in a "deadend." By the X-ray, the average emptying time was three-quarters of an hour, and the appearance was that of a normal stomach. There were no unpleasant by-effects and the results were excellent except in 3 cases, in which the operation failed to reduce sufficiently the acidity. In one of these, melæna occurred, but the patient recovered and has been well since. In the 2 other cases, jejunal ulcers developed in

Fig. 12. *A*. Lifting abdominal wall so as to put adhesions on stretch. *B*. Aspiration of dilated and prolapsing stomach. *C*. Specially made very long and also short scissors with knife edges and spade points. *F*. Suture of the small opening remaining.

the line of the acid stream. Finding that if a segment of stomach was left attached to the duodenum it contracted from disuse and gave no trouble, I approached the sections of the stomach, A, B, C (Fig. 8) toward the fundus. I then found that the nearer the division was made to the fundus, the more rapid the emptying time, and the greater the regurgitation as shown by the inorganic chloride curves (Figs. A and B)—the less the secretion evidenced by the total chloride curve (Figs. A and B), the lower the free acid (Figs. A and B), and the more satisfactory the result. In fact, the gastric analysis was the same, or perhaps a little better, than in a gastrectomy (Fig. B). Probably the alkaline secretion from the distal part of the stomach improved the diluting and neutralizing value of the duodenal contents. Thus was evolved an operation as simple as a gastro-enterostomy, giving the same results as, but without the mutilation of, a gastrectomy, which might be called a partial gastric exclusion (Figs. 8, 9, and 10). This operation can not be employed if there is any duodenal obstruction.

Figure A shows the average curves in gastric analysis when partial gastric exclusion is done. The absence of food in the gastric mill tends to a little hyposecretion; the size and position of the stoma, and the short loop ensure very good alkaline regurgitation. Eight of these cases have been operated upon, 7 in the last 12 months, 1 has been done 8 years. They have given no trouble, and the patients could *not* be better.

Sixty-five to 70 per cent of gastro-enterostomies for all types of duodenal ulcer were successful. This seemed to depend chiefly on the ability of the operation to diminish greatly or abolish, acidity. Table I shows that the attainment of this effect was extremely uncertain. In fact, the consistent and complete

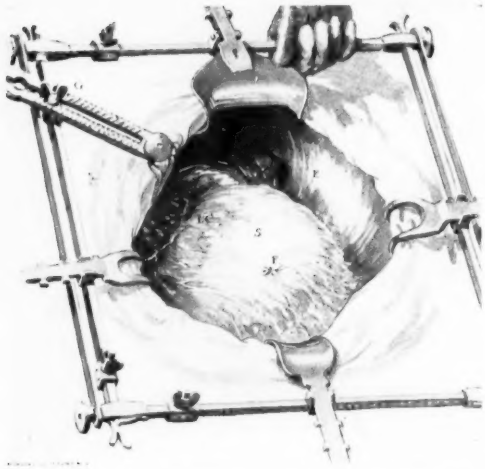

Fig. 13. Four blade lifting retractor for controlling anterior abdominal wall. *E.* Space obtained by lifting retractor, exposing œsophagus and whole of lesser curvature (LC) and stomach (S). *F.* Suture of trocar wound in stomach after aspiration. *G.* "Mechanical hand" holding left lobe of liver out of the way.

control of the all-important acid factor is one of our extreme difficulties.

MECHANISM OF ALKALIZING OPERATIONS

Therefore, in order to discover the mechanism, incidence, and degrees of alkalization in the various operations, a biochemical analysis of the gastric contents of 50 cases, representative of gastrectomies, partial gastric exclusions, modified Pólya operation, and successful and unsuccessful gastro-enterostomies for duodenal ulcer, was specially carried out for me by Dr. Leo Tighe, under the direction of Dr. Apperly, Acting Professor of Pathology, of the Melbourne University.

The estimations were made by the fractional method. The total chloride quantitative curve may be taken as the best measure extant of secretion, and the inorganic chloride (sodium chloride) curve would then be an indication of alkaline regurgitation.

The great interest of these investigations has been where they were done before and after each of several operations on the same case.

As a general rule a gastro-enterostomy for duodenal ulcer, in which there was no re-

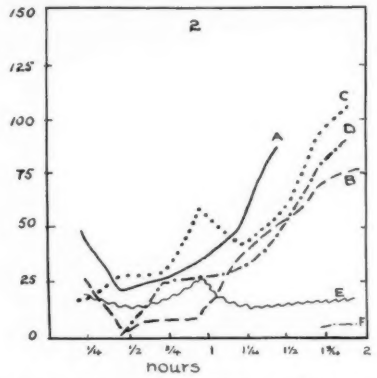

Fig. A. Average curves in gastric analysis of partial gastric exclusion. Line *A* represents the total chlorides after operation; line *B*, the inorganic chlorides after operation; line *C*, the total acidity before operation, line *C*, the total acidity after operation; line *E*, the free acid before operation; and *D*, the free acid after operation.

currence or reformation of ulcer, shows a very low, or absence of, free acidity (see Table I, Group A). This was also true of all the partial gastric exclusions and gastrectomies for duodenal ulcer. The modified Polya operations had a slightly higher free acid (see Table I, Group E and Fig. B).

Figure B is a comparison of the average secretory curves in these different operations.

The following observations may be made on the curves in Figure B:

1. The low acidity in successful gastro-enterostomy was due to good alkaline regurgitation (Fig. B, 2).
2. Even in extensive gastrectomies the alkalizing factor was as a rule due to great regurgitation (Fig. B, 2) rather than to a hyposecretion, and was thus almost similar in principle to successful gastro-enterostomy. It would appear that gastrectomy must be very radical to get a hyposecretion.
3. Free acid is lowest in gastrectomy for gastric ulcer, while this operation for duodenal ulcer gives a higher but still very low percentage of acid (Fig. B, 1).
4. Partial gastric exclusion (Fig. B, 2 and 3) gives almost the same regurgitation and secretory curves as gastrectomy.
5. The nearer the section of the stomach approached the pylorus (Fig. A and B, 2) in

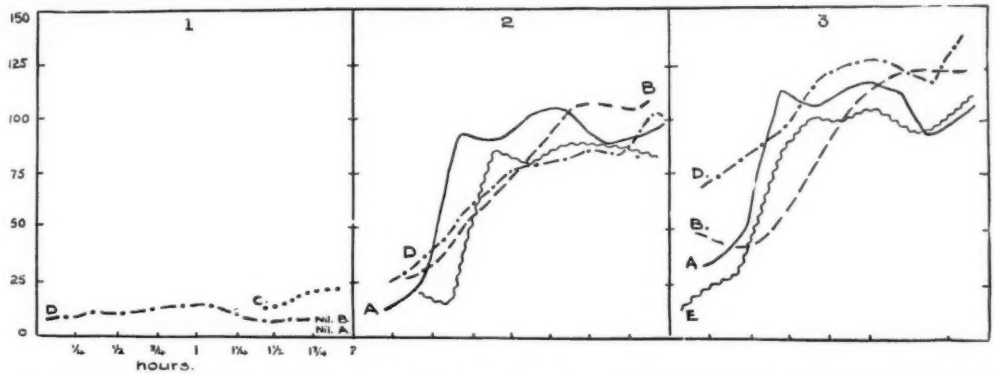

Fig. B. A series of charts illustrating a comparison of curves of successful gastro-enterostomy. *A*, Successful gastro-enterostomy; *B*, partial gastric exclusion; *C*, partial gastrectomy for duodenal ulcer; *D*, modified Pólya operation for duodenal ulcer; *E*, partial gastrectomy for gastric ulcer.

gastric exclusion the less the regurgitation and the higher the free acid. The emptying time also shortened as the stoma approached the fundus.

6. In only two cases of gastrectomy was there any evidence that the low acidity was partially due to a slight hyposecretion. This was also shown in one case of extensive partial gastric exclusion.

UNSUCCESSFUL GASTRO-ENTEROSTOMY

Table 1, Group B, in which the acidity had not been much altered by the operation, and Group C, Table 1, in which the acidity was actually higher after than before operation, contained the gastro-enterostomies which were unsuccessful. Either a jejunal ulcer or the original condition was present. Notwithstanding the acidity, a majority of patients in Group B did not complain of trouble. This confirms Apperly's investigations on this subject.

Figure C is a comparison of the secretory curves of successful (3) and unsuccessful gastro-enterostomy (1), with duodenal ulcer stomach (2).

The curves in Figure C bring out the following points:

1. In Curve 3 the good result was due to the absence of free acid (3, F.A.); that this was caused by a copious alkaline regurgitation, is shown by the high inorganic curve (see 2, I.C.); and that it was not caused by any hyposecretion, is shown by the high total chloride curve (3, T.C.).

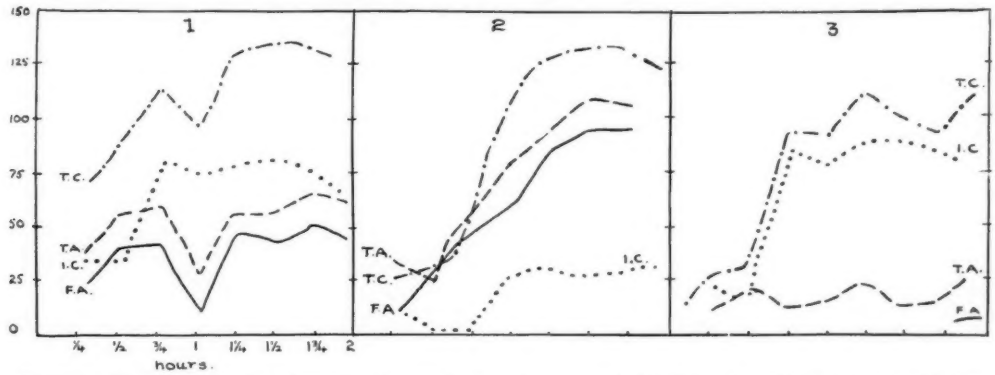

Fig. C. Comparison of curves of secretion in successful (3) and unsuccessful (1) gastro-enterostomy with duodenal ulcer stomach (2); F.A., free acid; T.A., total acid; I.C., inorganic chlorides; T.C., total chlorides.

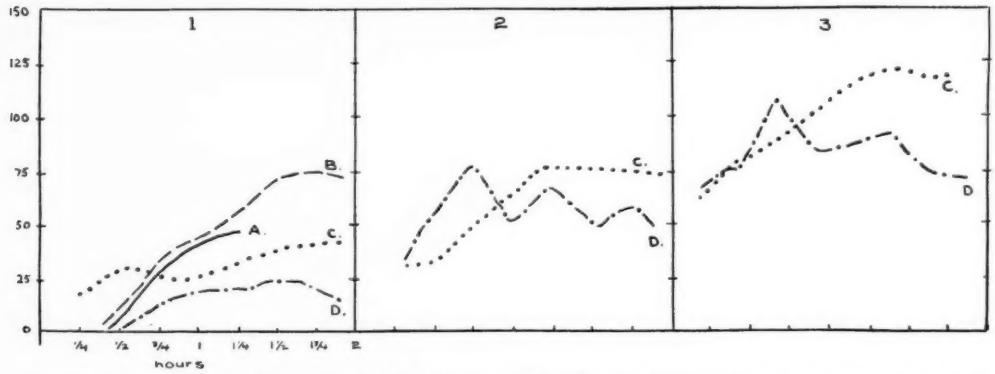

Fig. D (Case 1). 1, Free acid; 2, organic chlorides regurgitation; 3, total chlorides secretion. A, Before operation, very chronic duodenal ulcer was present; B, three weeks after modified Pólya operation was done, slight obstruction at the stoma; C, two years later when jejunal ulcer had formed; D, after extensive partial gastrectomy with short loop. One year later jejunal ulcer developed. The acidity was not greater but less.

2. In Curve 1 the operation failed, and jejunal ulcer developed because the acidity was insufficiently reduced (1, F.A.), following inadequate alkaline regurgitation (2, I.C.).

3. When the same case was undone, the regurgitation was almost nil (2, I.C.); this failure of natural regurgitation explains the very high acid (2, F.A.), and the probable reason why an ulcer developed. It might be called a duodenal ulcer stomach.

That failure of gastro-enterostomy, or even gastrectomy, is really due, as indicated by the above investigation, to failure of the operation for mechanical reasons to ensure adequate alkaline regurgitation, is proved by the following interesting case.

Case 1. The patient had a very old callous duodenal ulcer of the posterior wall. The free acidity was high (See Curve D, 1A.). The emptying time was 1½ hours. A modified Pólya was done. The acidity three weeks after operation was higher (See Curve D, 1B.), and the emptying time had increased to 2½ hours. One year later jejunal ulcer developed. The acidity had not increased; in fact, it was less (Curve D, I.C.). The jejunal ulcer was resected with an extensive partial gastrectomy. The acidity was now low, and regurgitation good in association with a slightly lesser secretion.

The very high acidity before operation became still higher three weeks after a modified Pólya. This failure was due to a mild obstruction, subsequently found, following an axial twist of the intestine, which lessened

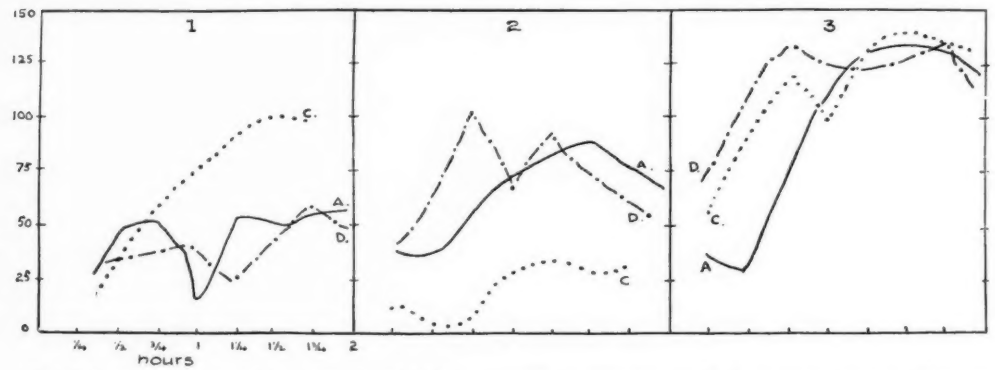

Fig. E (Case 2). 1, Free acid; 2, organic chlorides regurgitation; 3, total chlorides secretion. Comparison of gastro-enterostomy. A, Gastro-enterostomy undone; B, partial gastrectomy; D, on the same case.

TABLE I.—GASTRO-ENTEROSTOMIES. OBSERVATIONS TAKEN AT END OF 2 HOURS

Number		Free acid		Total acid	Inorganic chlorides after op.	Total chlorides	Comment
		Before op.	After op.				
1	Quite successful; no free acid.		nil	20	90	112	Well.
2			0		95	118	Well.
3			10		80	124	Well.
4	GROUP A		nil	16	?	?	Well.
5			0	28	74	102	Well.
6			nil	19	?	?	Well.
7	High acid; partial failure in a few of these cases.		14	27	81	108	E. T. delayed. No complaint.
8			20	28	74	112	Well.
9			31	40	51	101	Acidity and recurrence; had second operation.
10			24	36	76	112	Hæmatemesis after 5 years.
11	GROUP B		46	56	44	100	Good E. T. Complains pains. Perforated D. ulcer.
12			41	57	67	124	Developed jejunal ulcer.
13	Acid higher than before operation.	68	70				One-sixth residue in 6 hours.
14		25	58				Three-quarters residue in 6 hours.
15	GROUP C	26	55				
16	Absolute alkalinity—failures—"vicious circle."		0		?	?	
17			0				
18			0				
19	GROUP D		0				
20	Modified Pólya.		10	22	108	130	Very good; 3 years done.
21			8	40	84	96	Very good; 7 years done.
22	GROUP E		0	10	100	104	Very good; 8 years done.
23		36	44	56	76	126	E. T. before ¼ hour; now 2½ hours.
26	GROUP F Gastro-enterostomy with extensive resection of gastric ulcer.		nil	20	80	110	
27			nil				Extensive resection of lesser curvature.
28			nil	30	80	110	Extensive resection of lesser curvature.

alkaline regurgitation. The resulting hyperacidity probably caused the jejunal ulcer. After the jejunal ulcer had formed, the acidity was no higher, showing that the jejunal ulcer did not cause, but was really an incident of, hyperacidity.

Case 2. (Fig. E.) The patient had a duodenal ulcer and was subjected to the following operations (see Curve E):

(A) Cauterization of ulcer (Balfour) and gastro-enterostomy.
(B) Resection of jejunal ulcer.
(C) Gastro-enterostomy undone for recurrence of symptoms; slight axial twist of the intestine was found.
(D) Extensive partial gastrectomy 5 weeks after C by the long loop and anticolic Balfour-Pólya method. After this latter, the X-ray showed an emptying time of 1¾ hours, which was very slow for a gastrectomy, and indicated mild obstruction.

From the curves in Figure E the following observations may be made:

1. That gastro-enterostomy for duodenal ulcer failed to reduce acidity (1, A) because of a poor regurgitation (2, A). This was found to be due to an axial twist of the intestine, which caused mild obstruction and therefore lessened regurgitation.

2. The acidity, when the gastro-enterostomy was undone, was much worse, because there was now scarcely any regurgitation (2, C). The secretion was also high.

3. Even gastrectomy did not completely bring down the acid, because of a mild obstruction, shown by a ¾-hour (X-ray) emptying time. This caused partial failure of regurgitation. There was in this case an initial very high acidity. Another examination was made on this patient three months after the gastrectomy. It was then found that the emptying time of the stomach was now ½ hour, the percentage of free acid had gone down, and the alkaline regurgitation had improved.

Apparently a mild obstructive kink had adjusted itself.

It would thus appear, as partial gastrectomy relies almost wholly on regurgitation for its effect, that a partial gastric exclusion would give as good if not a better alkalization with much less trouble and danger, because there is a certain amount of alkaline secretion from the segregated gastric segment. If any untoward effect occurs reconstitution of the normal is very easy.

SURGERY OF GASTRIC ULCER IN RELATION TO THESE PRINCIPLES

Large resections for ulcers situated well toward the fundus of the stomach were successful, but unsatisfactory if done in any other region of the stomach.

The more of the stomach that was removed in a sleeve resection the lower the acidity and the more permanent and better the result. Where extensive resection, such as amputation of the lesser curvature, was combined with gastro-enterostomy, no better result was obtained in any series. Gastro-enterostomy is contra-indicated in the slack, roomy sympathetic gastric ulcer type of stomach, but it seemed to function excellently with the small stomach, which resulted after these big resections. The gastric ulcer type of stomach ends itself to an easy and safe performance of a partial gastrectomy, and indeed in these days when it has become comparatively safe in good hands no other operation should be considered, because unless the greater part of the distal inhibitory part of the stomach where probably the retention posture is much exaggerated is removed, a prime factor in the pathology of this ulcer will remain.

IDEAL GASTRO-ENTEROSTOMY

The modern surgeon comes to the conclusion that his most successful and permanent results are obtained in ulcer when he follows Nature's lead and materially modifies the gastric acidity by duodenal alkalinity. Gastrectomy, in the hands of the unskilled surgeon, is liable to kill more people than it would save, over and above gastro-enterostomy, and furthermore our biochemical analysis shows that it requires an operation very much more extensive than is usually supposed and therefore very dangerous if we are using it for its hyposecretory effects. Gastro-enterostomy must, therefore, still remain the basis of average gastric surgery.

In the light of the modern conception of regurgitation and its failure in diseases of the stomach, gastro-enterostomy should be, but is not, an ideal procedure, and experimental work should be directed toward the problem of ensuring a consistently successful gastro-enterostomy in every case. We know from our total chloride curves that hypersecretion is rare and that probably ulcer has very little effect in producing it (Case 2, Fig. D), but that, rather, ulcer is an incident of hyperacidity. Then, therefore, a gastro-enterostomy that fails to alkalize is probably a mechanical surgical failure and not due to the idiosyncrasy of the patient, though tone may be a possible factor. A study of unsuccessful gastro-enterostomies shows that in the failures there were two groups:

In Group 1, jejunal ulcer occurred, or the original duodenal ulcer recurred, in cases where there was an increase (Table 1, Subgroup C), or very little modification of the acidity after operation (Table 1, Subgroup B). This has been shown to be due to a lack of adequate alkaline regurgitation. When these cases were undone, they were found to have a mild obstruction due to an axial twist of the intestine, which explained the insufficient regurgitation. Some pain, or unsatisfactory convalescence, was a feature of these cases.

In Group 2, which were ghastly failures because of sickness and vomiting, the contents of the stomach were found to be quite alkaline (Table 1, Subgroup D), and always to contain bile. The regurgitation was enormous. The patients had in these instances suffered more or less from a vicious circle after the operation. In these cases a full spur in the coronal plane, which occasionally had a valvular effect with posture, projected into the stomach. This is the worst type of spur gastro-enterostomy, but it ensures complete regurgitation and absolute alkalization, and is exactly opposite in its effects to the axial intestinal twist which limits regurgitation, and may increase acidity in Table 1, Subgroup D. The former is comparable to the spur in a sigmoidostomy and projects the whole of the duodenal contents into the stomach. There was, of course, never a question of jejunal ulcer or recurrence of ulcer.

It is probable from this that if a very mild spur formation could be consistently produced to project the alkaline duodenal contents by direct peristaltic action into the stomach, a successful gastro-enterostomy would be produced. In the successful gastro-enterostomy group the emptying time was

short—from 15 to 30 minutes—the regurgitation high, and there was very little free acid. Most of the food went by the stoma, and very little by the pylorus. The stoma was in the most dependent position of the stomach. If the control of the acid factor was right, then the drainage and other factors seemed of necessity to be right.

THE PATHOLOGY AND TREATMENT OF DUODENAL ILEUS

Assuming that duodenal ileus was due to obstructive pressure of the superior mesenteric artery on the duodenum, I have, since 1918, anastomosed the dilated duodenum to the jejunum, and although the results showed a slight improvement in some cases, in the majority they were unsatisfactory. In one of the latter, in which the duodenum was enormous, I had occasion to re-open the abdomen, when I found that although a large stoma functioned, the duodenum had not contracted with the relief of obstruction (Fig. 11). This observation suggested that the condition, in some cases, must be due to a neuromuscular derangement above the duodenal rudimentary sphincter—an exaggerated retention posture, comparable to the sympathetic type of stomach, or cardiospasm, or to a similar condition which I have seen occur above the rudimentary midgastric sphincter. This is confirmed by the observations that megaloduodenum occurs in children, and that it is unusual to see in this type any definite evidences of the hypertrophy that should be present with obstruction. My present practice, limited to 2 cases, is to exclude the paralyzed duodenum and a variable amount of stomach (Figs. 8, 9, 10), and make the gastro-entero-anastomosis as close to the duodenum as possible. This allows these segments to contract from dysfunction, and also improves the function of the usually co-diseased hypotonic stomach. Gastro-enterostomy or duodeno-jejunostomy, in these neuromuscular conditions, is not sound.

AN EXTREME TECHNICAL DIFFICULTY—THE ART OF OPERATING ON VERY DIFFICULT SECONDARY GASTRIC OPERATIONS

There can be extraordinarily difficult operations in gastric and duodenal ulcer surgery. Apparently inoperable "ulcer tumor" with extensive and cartilaginous adhesions to the anterior abdominal wall, to any or all of the neighboring organs with complete involvement and great contraction of the lesser curvature, is one of the worst kind. If this type of ulcer is situated at the beginning of the gastric canal it is indeed a super-problem. Jejunal ulcer, with tumor formation, involving the mesentery of the jejunum, mesocolon, or the colon, and associated with a very short loop gastro-enterostomy, with a history of many operations, is even more difficult. Inflammatory tumor will respect the tissue planes, in fact will often accentuate them, and by following these planes, impossible looking operations will become easy, but a previous operation destroys these planes.

Every device and much skill is necessary to lessen shock in these formidable operations, and avoid immediate mortality. Instead of anoci-association we try to use as far as possible a "no-touch" method of operation. A lifting retractor (Fig. 13) which clamps soft, thick towels over the muscle onto the peritoneum is locked into the wound by gentle respiratory pressure. A control and protection of the abdominal wall is thus established and by lifting the upper or lower end a space is created for exploration and by using the Trendelenburg or the semi-erect position, organs can be made to drop into this "field of action" without any dragging. By lifting the retractor the intestines are aspirated into the abdomen. This retractor is used in conjunction with large, singlelayer scarves in which the intestine is allowed to tangle, and also with wire "mechanical hands." With these the scene of action can be segregated, the operation set without fear of disarrangement, and the anæsthetic decreased to a minimum (Fig. 13). The retractor gives wonderful exposure of the œsophageal end of the stomach—often a point of great difficulty in carcinoma or ulcer of the beginning of the gastric canal. It has saved me 30 per cent of physical exertion in my gastric and general abdominal work.

I attach great importance to the necessity of handling only a collapsed stomach. The preliminary emptying by a large trocar, especially of air, but also of any fluid, with

an electric air pump will make exploration and the clearing of adhesions (Fig. 12) easy, save much labor, and therefore shock. The left lobe of the liver is clamped out of the way with a "mechanical hand." The stomach is assailed from the rear through a long opening in the gastrocolic omentum. No clamps are used, and hæmostasis is carried out in a most painstaking fashion, and omental screens are freely used to protect the anterior and posterior parietes to prevent adhesions to these planes which are so painful and pernicious.

In jejunal ulcer I clear the stoma, working from the gastric and jejunal side of the transverse mesocolon, and disconnect the jejunum proximally and distally from the stoma, and draw the latter with the attached segment of intestine through the opening in the transverse mesocolon, and remove it and the pars pylorus of the stomach *en bloc*. Resection only, of jejunal ulcer, is of no value. The ulcer will return time after time, unless the cause is removed. Alterations of the stoma are also of no avail; tertiary and very difficult and dangerous operations will almost certainly be necessary unless a gastrectomy is done. We have found that this always ensures success, and is the safest in the end. Out of 250 cases of gastric and duodenal ulcer there has been no leakage from suture lines, and there has been a postmortem in each of the 5 deaths. This result I ascribe to the careful, painstaking hæmostasis and the routine protection of suture lines with split omental wraps.

SUMMARY

1. The conception put forth in this paper that the sympathetic imposes a retention postural tone on the gastric muscle affords an explanation of many clinical phenomena.

2. Alterations in gastric posture which are governed by the labile sympathetic, derange the natural alkaline duodenal protective regurgitation which controls acidity, and probably initiate a set of circumstances which may eventually result in ulcer.

3. In some ulcers hyperacidity is the controlling cause while in others some local loss of resistance such as infection, etc., is necessary for ulcer with a low acidity; in the former an alkalizing operation is essential.

4. Gastro-enterostomy is most uncertain in its regurgitant alkalizing effect.

5. Unless an old ulcer is resected in association with gastro-enterostomy recurrence even with a low acid from the residual infection of the ulcer is probable.

6. The good effects of gastrectomy in duodenal ulcer are due to the exclusion of the ulcer and to a better alkaline regurgitation rather than to any hyposecretion.

7. The same effect can be obtained in these old ulcers if unassociated with obstruction, by the partial gastric exclusion operation which is as simple, safe, and conservative, as a gastro-enterostomy, with the good effects of a gastrectomy. This is attained by eliminating the sympathetic retentive area of the stomach.

8. The gastric ulcer type of stomach lends itself with success to extensive resection of ulcer with gastro-enterostomy or to partial gastrectomy.

9. A method of operating on difficult gastric cases is suggested.

I wish to acknowledge my indebtedness to Mr. Darryl Lindsay who took such interest in illustrating this article. I have also drawn freely on the following authorities to whom I beg to make acknowledgment.

REFERENCES

1. Apperly, F. L. M. J. Australia, 1923, January, p. 33.
2. Idem. M. J. Australia, 1924, March 15.
3. Bayliss. Principles of General Physiology.
4. Bolton, C. Diseases of the stomach: modern methods of investigation. Brit. M. J., 1923, ii, 269.
5. Idem. J. Path. Bacteriol., 1915, xx, 133.
6. Bolton and Goodhart. Lancet, 1922, March 4, p. 420.
7. Dragstedt, L. R. Contributions to the physiology the stomach. Gastric juice in duodenal and gastric ulcers. J. Am. M. Ass., 1917, lxviii, 330.
8. Dragstedt and Vaughan. Studies of gastric surgery. Arch. Surg., 1924, May.
9. Gaskell. The Involuntary Nervous System.
10. Goodhart. Lancet, 1922, March 4.
11. Hunter. Postural influences of the voluntary muscle. M. J. Australia, 1924, January 26.
12. Hurst, A. F. The pathology, diagnosis, and treatment of duodenal ulcer. Brit. M. J., 1920, April 24.
13. Mann and Kawamura. Ann. Surg., 1922, February, p. 208.
14. Mann and Williamson. Experimental production of peptic ulcer. Ann. Surg., 1923, lxxvii, 409.
15. Matthes. Path. Anat., General, No. 13.
16. McClure, Reynolds, and Swan. Arch. Int. Med., 1921, June, p. 706.
17. Ivy, A. C. J. Am. M. Ass., 1920, December 4, 1540.
18. Idem. Physiology of the stomach. Studies on gastric ulcer. Arch. Int. Med., 1920, xxv, January 6.
19. Royle. A new operative procedure in the treatment of spastic paralysis and its experimental basis. M. J. Australia, 1924, January 26.

A COMPARISON OF SODIUM TETRABROMPHENOLPHTHALEIN WITH SODIUM TETRAIODOPHENOLPHTHALEIN IN GALL-BLADDER RADIOGRAPHY[1]

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THE recent discovery by Graham and Cole of a novel method whereby roentgenographic visualization of the gall bladder may be obtained has aroused the interest of workers in both laboratory and clinic. In their first paper (1) these authors state: "Preliminary tests of intravenous injections of the sodium salt of tetrachlorphenolphthalein into experimental animals failed to reveal satisfactory roentgen-ray shadows of the gall bladder. Because of the similarity of chemical structure, it was thought that tetraiodophenolphthalein would also be excreted into the bile and might cast a satisfactory shadow because of its iodine content. Roentgen-ray shadows of the gall bladder were revealed, but the substance seemed to be too toxic to permit its extensive use in man."

The reasons which led them to this conclusion are not detailed and it is sufficient to say that in a search for the preferential compound for their purposes they first advocated calcium tetrabromphenolphthalein (1) and more recently sodium tetrabromphenolphthalein (2, 3). The series of experiments here reported indicate that sodium tetraiodophenolphthalein has definite advantages over the analogous bromine salt for use in biliary cystography.

I. COMPARATIVE OPACITY OF THE TWO SALTS TO X-RAYS

Elements are opaque to X-rays approximately in proportion to their atomic weights. The atomic weight of bromine is 80, while that of iodine is 127. Sodium tetrabromphenolphthalein contains 47 per cent of bromine; sodium tetraiodophenolphthalein contains 59 per cent of iodine. Hence the relative opacities of the two compounds may be expressed by the following formula:

$$\frac{80\text{ (atomic wt. of Br.)} \times 47\text{ (percentage in salt)}}{127\text{ (atomic wt. of I.)} \times 59\text{ (percentage in salt)}} = \frac{3760}{7493}$$

The ratio of the opacity of the bromine salt to the iodine salt then is approximately 1 to 2.

Theoretically it should require only about 50 per cent as much of the iodine as of the bromine salt to produce the same density of shadow in a radiograph. The relative opacities of the two salts are indicated in the accompanying figures. Figure 1 shows a roentgenograph of beakers containing 10 per cent solution of each salt at a depth of 5.5 centimeters, indicating a much greater opacity of the iodine solution.

In Figure 2 we aimed to produce shadows of equal density. For this it was necessary to have a depth of solution of iodine salt of 3.8 centimeters while that of the bromine salt was 5.5 centimeters, indicating a relative opacity in favor of the iodine solution, not the 2 to 1 ratio which would be expected from computation but this discrepancy may be due to the conditions of the experiment.

II. COMPARATIVE DOSES NECESSARY FOR GALL-BLADDER SHADOWS IN DOGS

In these experiments 42 animals (an equal number for each salt) were used. The average dose required to obtain a shadow of the gall bladder was 0.18 gram per kilogram body weight for the iodine salt and 0.32 gram per kilogram for the bromine salt. Reduced to percentage it required on the average only 56 per cent as much of the iodine salt as of the bromine salt to produce a shadow of the gall bladder. For example (see Fig. 3) under the same conditions, at successive sessions a dog was given 0.09 gram per kilogram of the iodine salt and, at a subsequent sitting, 0.25 gram per kilogram of the bromine salt, resulting in roentgen-ray shadows of approximately equal

[1] From the Laboratory for Surgical Research of Harvard Medical School and the Surgical Clinic at the Peter Bent Brigham Hospital.

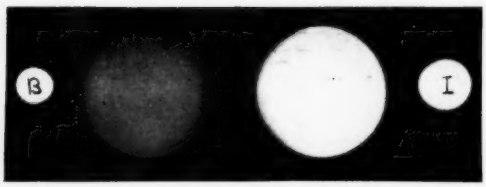


Fig. 1. To show comparative opacity of 10 per cent solutions of bromine salt (left) and iodine salt (right) at equal depths.

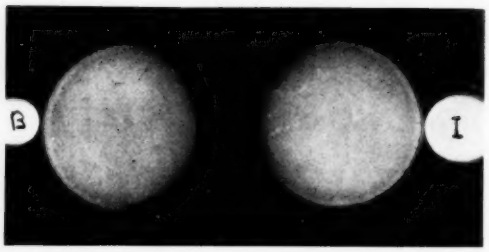


Fig. 2. To show comparative opacities of the bromine and iodine salts. The depth of the bromine solution (left) is 5.5 centimeters—of the iodine solution (right) is 3.8 centimeters.

density. In other words nearly three times as much was required of the bromine as of the iodine salt.

Even with maximum, and in many cases lethal doses, we were able to get shadows in only 19 per cent of the dogs injected with the bromine salt as compared with 81 per cent injected with the iodine salt. This discrepancy in shadow producing power is illustrated by Figure 4. The left hand plate shows the biliary cystogram of a dog injected with a lethal dose of the bromine salt, while the gall-bladder shadow shown in the plate on the right was secured by a dose of the iodine salt so small that the animal showed no untoward symptoms.

Another striking example of the greater opacity of the iodine salt in the gall bladder, resulting in greater facility in securing cystograms, may be seen in Figure 5. Two dogs were injected with doses of the iodine and bromine salts which proved lethal in 6 to 7 hours. The gall bladders were removed with their contents and exposed on the same plate. The denser shadow cast by the gall bladder containing the iodine salt (lower shadow in Fig. 5) indicates superior shadow producing power for that compound.

That a good biliary cystogram may be obtained by a comparatively small dose of the iodine salt is shown in Figure 6. This plate was taken 6 hours after a dose of 0.1 gram per kilogram. The lethal dose in this animal was 0.6 gram per kilogram, divided over a period of 4 hours.

III. COMPARATIVE TOXICITY OF THE TWO SALTS

In these experiments 8 rabbits, 15 cats, 17 dogs, and 43 guinea pigs were used—83 animals in all. The drugs were given intravenously. The experiments on guinea pigs were done last, after fairly definite ideas had been obtained as to the toxicity of the two salts on larger animals. On account of the slight variation between fatal and non-fatal doses, and the approximately equal numbers that lived and died under the experiment, these results would appear to be fairly reliable and significant. The toxicity experiments are summarized in the following tables:

In Table I it will be seen that rabbits varied greatly in their reactions to the salts. One died after a dose of 0.12 gram per kilogram of the bromine salt while another lived after a dose of 0.21 gram per kilogram. On account of this variability comparatively few of these animals were used.

The figures in Table II indicate very little difference in the toxicity of the two salts to cats.

In Table III the toxicity in dogs is indicated. The object in these experiments was not primarily to determine toxicity but to produce cholecystograms. For this reason only a few animals received single lethal doses and the figures given may not be accurate. The results show no significant difference in the two salts.

The results of the toxicity studies in the 43 guinea pigs are shown in Table IV, in which attention may be called to the slight variation in fatal doses and the narrow margin between fatal and non-fatal doses. Ten animals died and 10 lived with the bromine salt; and 10 died and 13 lived with the iodine salt. We believe these results indicate no appreciable difference in the toxicity of the two salts.

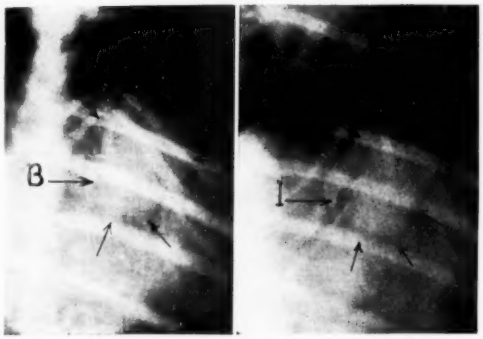


Fig. 3. Roentgenograms of the same dog injected at different times with 0.25 gram per kilogram of the bromine salt (left) and with 0.09 gram per kilogram of the iodine salt (right).

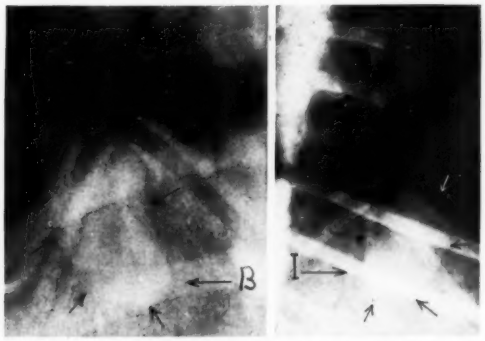


Fig. 4. Comparative cystograms of a dog that had been injected with a lethal dose of the bromine salt (left) and of a dog that had been injected with a non-toxic dose of the iodine salt (right).

Symptoms of toxicity. The effects on the animals were about the same with both salts. Large doses produced hyperpnœa (and in dogs usually vomiting) at once, rapid onset of weakness, restlessness, drowsiness, occasionally diarrhœa, and finally prostration, coma, and death.

In guinea pigs the death was often sudden. A minute or so after injection the pig would become cyanotic, gasp for breath, and rapidly expire. In other cases the symptoms were hyperpnœa, prostration, coma, and death after one to several hours. Generally it could be told from the degree of apparent shock very soon after injection what the result would be. All that died after injection of the bromine salt did so at once. A few died soon after the injection of the iodine salt but the majority lived an average time of 3 hours.

Elimination of the salts. In dogs the fatal divided doses (given over a period of 4 to 6 hours) were, with both salts, approximately twice as large as fatal single doses. This indicates a rapid elimination of the salts. Sublethal doses were given 2 days in succession without being fatal to the animals.

From these experiments it seems that there is very little difference in the toxicity of sodium tetrabromphenolphthalein and sodium tetraiodophenolphthalein. The lethal dose is about the same with each drug.

However, because of the necessity of using only approximately one half as much of the iodine as of the bromine salt to obtain a shadow of the gall bladder, there is practically a wide margin of safety in favor of the iodine compound.

IV. A COMPARISON OF THE EFFECTS OF THE TWO SALTS IN A HUMAN SUBJECT

The subject (one of the authors) was in perfect health, 32 years of age, and weighed 68.2 kilograms. During the test the rules of conduct laid down by Graham and Cole (3) were followed.

Bromine salt test. Five and one half grams of sodium tetrabromphenolphthalein (Mallinckrodt) dissolved in 40 cubic centimeters of distilled water were injected into the basilic vein. After insertion of the needle a few cubic

Fig. 5. Roentgenogram of two gall bladders removed from dogs injected with doses of the iodine and bromine salts which proved lethal in 6 to 7 hours. The lower shadow is that containing the iodine salt.

Fig. 6. A shadow of the gall bladder in a dog obtained by a dose of 0.1 gram per kilogram of the iodine salt. The lethal dose in this dog was 0.6 gram.

centimeters of saline was run in from a gravity apparatus to be sure the needle was in the vein; then the solution of the salt was run in followed by 200 cubic centimeters of saline. Contrary to the practice of Graham and Cole, the salt was injected in a single dose over a period of 15 minutes.

During the injection slight pain and heaviness was felt in the vein, and the pulse went from 75 to 116 and the respiration from 20 to 24. Three hours later the pulse and respiration were 87 and 20. There were never any significant changes in temperature or blood pressure.

The subject had a slight headache, considerable lumbar pain and some drowsiness until 6 hours after injection when he began to grow nauseated and to have slight abdominal cramps. After a trip to the X-ray laboratory, half an hour later, he vomited water and mucus and had a free, soft bowel movement. An hour later he vomited bile, and repeated this performance an hour and half after that, following another trip to the X-ray laboratory. This time he retched quite vigorously, but soon began to feel better and 3 hours later ate toast and cocoa. The next day after a good sleep he felt much better, ate well,

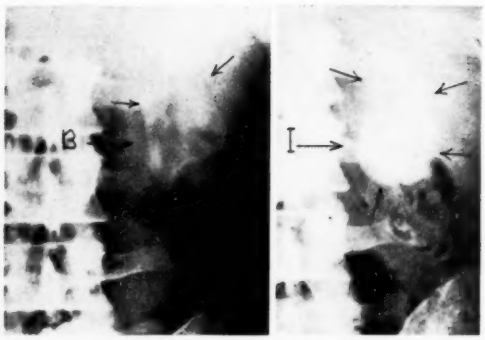


Fig. 7. Comparison of 6 hour plates after experimental injection in man of 0.08 gram per kilogram body weight of bromine salt (left) on one occasion, and of 0.05 gram per kilogram of iodine salt (right) on another occasion.

but was weak and tired, and had considerable soreness in the lower back. In two days he had completely recovered except for a slight tenderness in the injected vein.

Iodine salt test. Eight days after the injection of the bromine salt, 3.5 grams of sodium tetraiodophenolphthalein[1] dissolved in 50 cubic centimeters of water to which 1.5 cubic centimeters of 10 per cent sodium carbonate had been added, was injected. The alkali is necessary in order to keep the salt in solution, but otherwise exactly the same procedure as with the bromine salt was carried out. During the injection slight pain was felt in the arm, and the pulse rose from 75 to 88. No changes in respiration, temperature, or blood pressure were recorded.

Six hours after the injection some drowsiness was experienced, but there was no headache, no nausea, no soreness of the back and no restlessness. After 9 hours the subject was hungry and ate toast and cocoa as before. At night he was somewhat weak. He slept well. In the morning his back was tired and sore. The second day he had completely recovered.

The dose given in the bromine salt test was 0.08 gram per kilogram body weight; the dose given in the iodine salt test was 0.05 gram per kilogram. Yet it will be seen from the roentgenograms (Figs. 7 and 8) that the denser shadow was produced by the iodine salt. This shadow also persisted longer, being still present in the 24 hour plate, shown in Figure

[1]Salt obtained from the Eastman Kodak Co., Rochester, N. Y.

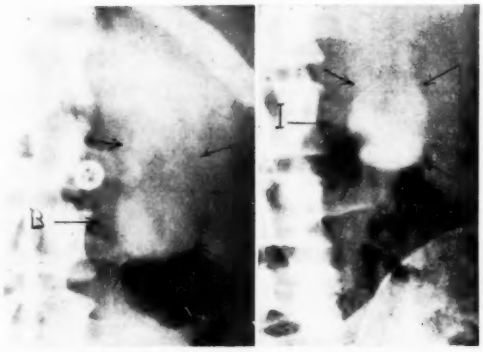


Fig. 8. Nine hour plate under conditions mentioned in Figure 7.

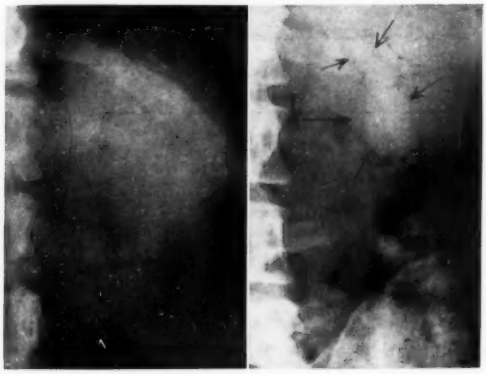


Fig. 9. Twenty-four hour plate under conditions mentioned in Figure 7. Bromine salt shadow no longer visible.

9. Both the iodine and bromine shadows, however, had disappeared in 32 hours.

The smaller dose of the iodine salt required for shadow which was accompanied by none of the toxic symptoms resulting from the dose of bromine salt, points to a superiority of the iodine salt for clinical use in biliary cystography.

In Figures 7, 8, and 9 are shown the plates taken at 6, 9, and 24 hour intervals after injections on different occasions with the bromine and iodine salts. For purposes of comparison they are placed side by side.

V. A SUMMARY OF COMPARATIVE RESULTS IN DOGS

In Table V are set forth in summary, the results after injection of the bromine and iodine salts in dogs. Owing to the small number of animals injected with single lethal doses the figure for the bromine salt under average lethal dose may be too low. Attention may be called to the following facts:

The minimum dose for shadow was twice as much with the bromine as with the iodine salt; the average dose given when shadows were obtained was nearly twice as much with the bromine as with the iodine salt. The average lethal dose was about the same with each drug. Only 19 per cent of the dogs which were injected even with lethal doses of the bromine salt showed gall bladder shadows as against 81 per cent which were injected with the iodine salt.

TABLE V. COMPARISON OF SODIUM TETRABROMPHENOLPHTHALEIN AND SODIUM TETRAIODOPHENOLPHTHALEIN FOR BILIARY CYSTOGRAPHY IN DOGS

	Brom. salt Grams per kg.	*Iodo. salt* Grams per kg.
Minimum dose for shadow	0.21	0.1
Average dose given when shadows were obtained	0.32	0.18
Average lethal dose (single)	0.26 (3 dogs)	0.3 (4 dogs)
Maximal lethal dose (divided over 4 to 6 hours)	0.73 (12 hrs.)	0.6 (6 hrs.)
Percentage of dogs injected showing shadow	19	81
Percentage of failures with average dose or more	80	17
Number of dogs used	21	21

VI. SUMMARY AND CONCLUSION

On account of the greater atomic weight of iodine, sodium tetra*iodo*phenolphthalein should be nearly twice as opaque to X-rays as sodium tetra*brom*phenolphthalein.

In practice nearly twice as much of the bromine salt as of the iodine salt is required to obtain a shadow of the gall bladder.

Our experiments indicate no appreciable difference in the toxicity of the two drugs.

Consequently, for use in biliary cystography, there appears to be a wide margin of

TABLE I.—TOXICITY IN RABBITS

(All intravenous doses)	Bromine Salt (5 animals)		Iodine Salt (3 animals)	
	Dose	Result	Dose	Result
Single fatal doses (one with each salt)	Gms. per kg. 0.12	Death in a few seconds	Gms. per kg. 0.22	Death in 1 hour
Average single non-fatal dose	0.21	Recovery	None given	
Average divided fatal dose given over period of about 1 hour	0.37	Death in 1 hour (Average)	0.4	Death in 23 hours (Average)

TABLE II.—TOXICITY IN CATS

(All intravenous doses)	Bromine Salt (8 animals)		Iodine Salt (7 animals)	
	Dose	Result	Dose	Result
Average single fatal dose	Gms. per kg. 0.21	Death in 5 hours (Average)	Gms. per kg. 0.22	Death in 10 hours (Average)
Average single non-fatal dose	0.2	Recovery		
Average divided fatal dose given over a period of 2 to 3 hours	0.37	Death in 8 hours (Average)	0.33	Death in 8 hours (Average)

TABLE III.—TOXICITY IN DOGS

(All intravenous doses)	Bromine Salt (10 animals)		Iodine Salt (7 animals)	
	Dose	Result	Dose	Result
Average single fatal dose	Gms. per kg. 0.26	Death in 7 hours (Average)	Gms. per kg. 0.30	Death in 6 hours (Average)
Average single non-fatal dose	0.21	Recovery	0.24	Recovery
Average divided fatal dose given over a period of 1 to 5 hours	0.51	Death in 6 hours (Average)	0.5	Death in 4 hours (Average)

TABLE IV.—TOXICITY IN GUINEA PIGS

(All single intravenous doses)	Bromine Salt (20 animals)		Iodine Salt (23 animals)	
	Dose	Result	Dose	Result
Average fatal dose	0.23 gms. per kg. (Variation 0.20 to 0.27)	Death in few minutes (Average)	0.21 gms. per kg. (Variation 0.21 to 0.22)	Death in 3 hours (Average)
Average non-fatal dose	0.21 (Variation 0.20 to 0.25)	Recovery	0.21 (Variation 0.20 to 0.22)	Recovery

safety in favor of sodium tetraiodophenolphthalein over the analogous bromine compound.

BIBLIOGRAPHY

1. Graham, E. A., and Cole, W. H. Roentgenologic examination of the gall bladder. J. Am. M. Ass., 1924, lxxxii, 613–614.

2. Graham, E. A., Cole, W. H., and Copher, G. H. Visualization of the gall bladder by the sodium salt of tetrabromphenolphthalein. J. Am. M. Ass., 1924, lxxxii, 1777–1778.

3. Graham, E. A., Cole, W. H., and Copher, G. H. Roentgenological visualization of the gall bladder by the intravenous injection of tetrabromphenolphthalein. Ann. Surg., 1924, lxxx, No. 3, 377–473.

POSTOPERATIVE LEUCOCYTOSIS

A Study of Thirty Cases from the Wards of the Woman's Hospital in the State of New York[1]

By MARGARET S. WITTER, A.B., M.D., New York

THERE often arise, during the course of a case, occasions when the leucocyte count is desired as an aid in the diagnosis and prognosis of postoperative events. In order critically to interpret such a postoperative count, it is necessary to have some judgment as to the average normal count after operation, and as to the limits which may be considered normal and beyond which one should be suspicious of untoward events.

Postoperative leucocytosis has been studied from many angles—the source, the causative factors et cetera—with varying results.

It has been generally accepted that ether causes a leucocytosis, probably toxic in origin. However, DaCosta (4) found that the variations shown by the leucocyte count after ether anæsthesia were irregular and not more pronounced than would be found in the same number of normal samples on different examinations. In a later paper (5), he concluded that there was no direct relationship between duration of operation and blood disturbance nor quantity of ether used. However, he does state that he found an average increase of 4,586 after ether.

Hamilton Fish (6) believed that the leucocytosis of anæsthesia was phagocytic in character and a measure of individual resistance.

Cabot and his co-workers (3) seldom found a marked rise after ether, but a decided rise after operation, with a fall to a much lower figure in 36 hours, as follows:

	Leucocytes
After ether	7,200
After operation	27,300
After 36 hours	13,700

Cabot therefore concludes that, following the operative procedure, there is a leucocytosis, often marked, which disappears in 36 hours.

Meleney (10), in 1918, made a very thorough study of 51 non-infective, general surgical cases. He concluded that an operation performed under anæsthesia, is sufficient injury to cause a marked increase in leucocytes, and that the greatest reactions were obtained from severe trauma, many foreign bodies such as sutures, long anæsthesia especially with ether, and much loss of blood.

In 1922, Scott (12) studied a series of gynecological cases after operation, following them every first, third, fifth, etc. day. He concluded that in gynecological cases with no history of previous infection, the postoperative leucocyte count, during certain intervals of convalescence, is practically constant. He believes that during convalescence following five common types of gynecological operations, one can be sure in most cases, with no gross complications, of the leucocytosis at stated intervals.

Schilling (13) places blood examinations on a par with temperature, urinalysis, pulse, auscultation, and percussion. He believes it has a fundamental value in determining the status præsens, and aids not only in judgment

[1]This study was made as part of the work of the elective course in gynecology of Cornell University Medical College during the senior year by Margaret S. Witter and William Perry Elliott. The observations and compilation of the data were done by these students working together and the First Polk Prize in Gynecology was awarded to Dr. Witter for the best thesis.—George Gray Ward, Professor of Obstetrics and Gynecology.

of symptoms but throws also a vivid light on prognosis.

If we are to accord the leucocyte this high rank among our data, we must perfect our judgment of the normal leucocyte values. Therefore, it seemed to us that a study of a number of average, "clean" cases with uneventful recoveries would afford some basis for such a judgment of the normal postoperative leucocyte curve. It is the purpose of this article to present a study of 39 such cases from the wards of the Woman's Hospital in the State of New York, done under what we consider to be practically standard conditions. That is:

1. The cases were entirely from the service of Dr. George Gray Ward. They had no complicating events throughout their entire postoperative course, and were of the type considered by Dr. Ward as average, "clean" cases.

2. The pre-operative preparation, the anæsthesia, the operative procedures, the immediate and later postoperative care, all conformed to standard technique.

3. The counts used as data in Series I were done by M. M., an experienced technician, doing all routine counts in the hospital and using consistent technique. The counts used as data in Series II were done by W. E. and M. W., under standard conditions.

Series I

METHOD

Thirty cases were studied. A pre-operative count was taken some time during a 1 to 3 day pre-operative interval. We assumed that, under non-varying conditions, an uninfected case should have a fairly constant count preoperatively; and we found this to be true in several cases in which daily pre-operative counts were done for a week. Therefore, these counts have been charted as "pre-op," irrespective of the exact day.

Beginning with the first postoperative day, counts were then done daily for 5 to 8 days.

The counts were taken in the routine manner and counted on a double Neubauer slide, two preparations from each pipette being counted, and agreeing within a limit of ten cells.

The differential counts were, unfortunately, because of lack of time on the part of the technician, done by the counting chamber method. This method was introduced (8) by Zappert in 1892, and has been worked over by various men since as affording a quick and easy method of differential counting. However, Thro and Richards (14) believe that this method is inaccurate, especially when dealing with young polynuclear forms. Since the method is also used successfully at New York Hospital for surgical cases, we believe that it is at least clinically accurate, and has given the general direction of the differential curve, although the wide daily variation makes us feel that the method is inexact. However, since the data were compiled several months (January to May, 1923) before this analysis was undertaken there was no opportunity of change.

OBSERVATIONS

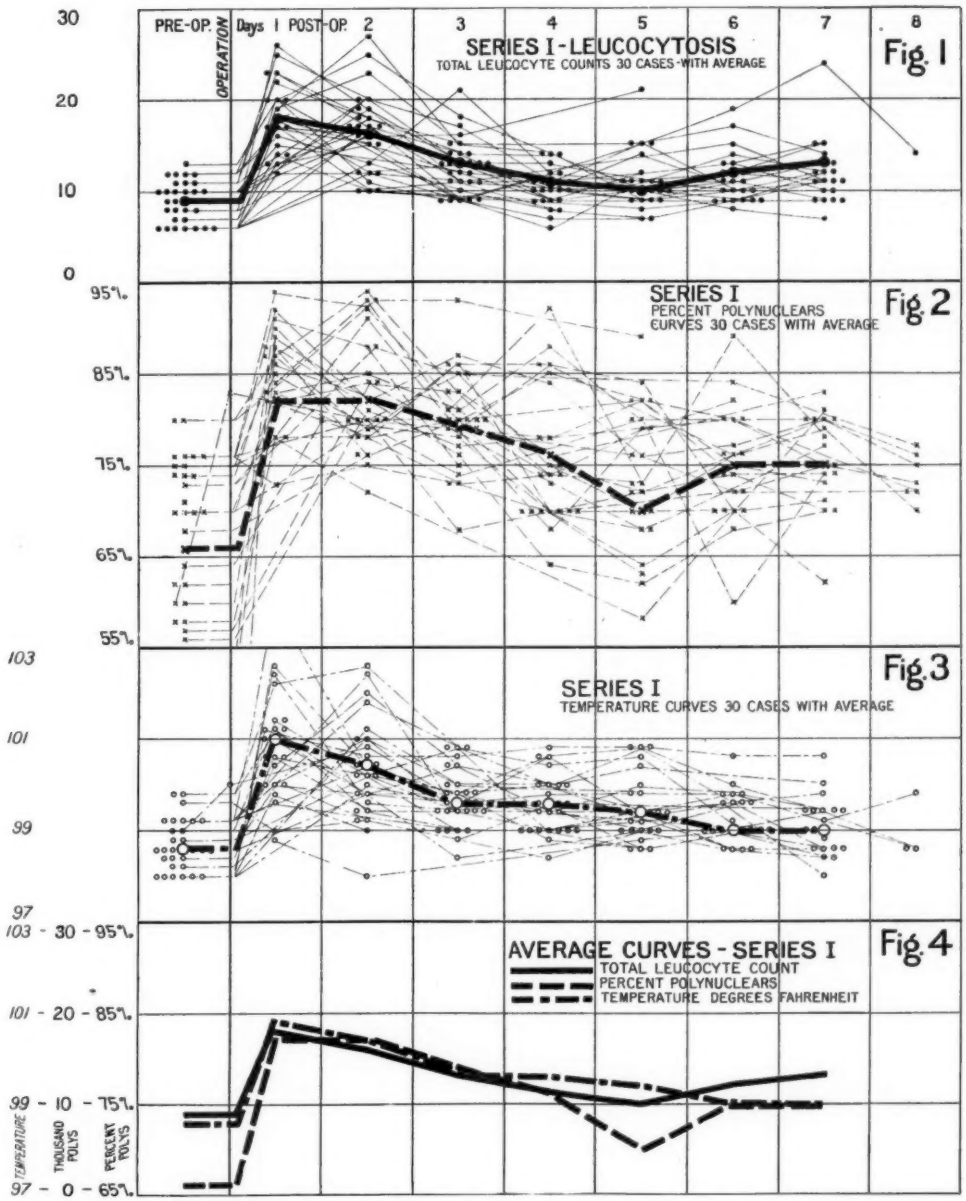
TABLE I. TOTAL LEUCOCYTE COUNTS

Day of count	Number of cases	Minimum	Maximum	Average
Pre-op.	30	6000	13000	9000
1	21	12000	26000	18000
2	24	10000	27000	16000
3	28	9000	21000	13000
4	25	6000	21000	11000
5	23	7000	19000	10000
6	23	8000	19000	12000
7	18	7000	24000	13000

Table I shows the minimum, maximum, and average total leucocyte counts for each

TABLE II. PERCENTAGE OF POLYNUCLEARS

Day of count	Number of cases	Minimum	Maximum	Average
Pre-op.	30	42	80	66
1	20	73	94	82
2	26	75	93	82
3	28	73	93	79
4	24	64	87	76
5	24	58	74	70
6	17	70	84	75
7	21	62	83	75



Figs. 1, 2, 3 and 4. Composite charts of series 1 showing average and range of the leucocytosis, polynuclear percentage and temperature curves in 30 non-septic cases of abdominal section with normal convalescences.

day, with number of cases counted. The same is shown graphically in Figure I.

Table II shows the minimum, maximum, and average percentage of polynuclears for each day, with the number of cases. Graphically recorded in Figure 2.

TABLE III. TEMPERATURES (DEGREES FAHRENHEIT)

Day of count	Number of cases	Minimum	Maximum	Average
Pre-op.	30	98.0	99.8	98.6
1	22	98.8	104.0	100.8
2	25	98.0	102.8	100.4
3	28	98.4	100.8	99.6
4	25	98.4	100.8	99.6
5	26	98.6	100.8	99.4
6	22	98.6	100.6	99.0
7	23	98.4	100.6	99.0

Table III shows the minimum, maximum, and average temperatures for each day, with the number of cases. Graphically recorded in Figure 3.

These three average curves are superimposed in Figure 4, to show the relationship of total leucocytes, polynuclear percentage, and temperatures.

In the graphic figures, the relationship of total leucocyte count and polynuclear percentage, is that used by Gibson (7) in his standard chart. In this, he considers 10,000 leucocytes and 75 per cent polynuclears as the normal, which, being slightly high, cares for all personal idiosyncrasies. From these up, the normal relationship is as charted. He considers an upward deviation from this normal, as, 10,000 leucocytes with 90 per cent polynuclears, as indicative of serious lesion or poor resistance. The added relationship of temperature has been assumed as being generally true, and it was found convenient for this study.

DISCUSSION

From Figure I, we can see that there is a leucocyte curve which is highest on the first day after operation, at 18,000. It then steadily declines to normal on the fifth day (10,000), and then rises slightly on the sixth and seventh days.

The cause of this secondary rise has not been determined, nor its duration. It has been suggested that the absorption of suture material at this period may be the etiological factor.

This curve agrees with Romani (11) who found in a series of postoperative cases, that the leucocyte counts rose in a very short time and came to normal on the fifth day. Meleney (10) found normal values again on the fourth day.

The leucocytosis would seem to be mainly a polynucleosis. The pre-operative differentials show a low percentage of polynuclears, —average 66 per cent—Table II. The operation is followed by a rise and the curve remains at its height for 2 days and descends a bit more slowly than the total leucocyte curve.

The temperature curve, likewise, Figure 3, shows its peak on the first day and descends slowly to high normal—99.0—on the sixth day. The figure showing the average temperature curve would lead one to believe that the leucocytes and temperature bear a constant, direct relationship, but the individual charts appended show that the relationship is not so close.

Attempts were made by re-grouping the cases according to the type and duration of the operations, to show other relationships between these factors and the leucocyte jump after operation. Groups were made by type of operation, and duration.

By operation:

Group 1(9 cases, Table IV). Laparotomy: hysterectomy, salpingectomy, oophorectomy, appendectomy, retroversion; pelvic floor: rectopexy, amputation cervix, relaxed pelvic floor.

Group 2 (14 cases, Table V). Laparotomy: hysterectomy, retroversion, oophorectomy, appendectomy.

Group 3 (5 cases, Table VI). Pelvic floor plus dilatation and curettage.

Group 4 (2 cases, Table VII). Dilatation and curettage; stem pessary.

Tables IV, V, VI, and VII show the four groups and Table VIII compares their averages. We can see no significant difference in

Groups 1, 2, and 3, but in Group 4 in which there was little trauma and in which each operation required but 30 minutes, there is a distinctly less marked rise than in the others.

TABLE IV. GROUP 1. LAPAROTOMY AND PELVIC FLOOR. 9 CASES

	Minimum	Maximum	Average
Pre-operative	6000	13000	10000
Postoperative	14000	25000	20000
Jump	6000	15000	10000

TABLE V. GROUP 2. LAPAROTOMY. 14 CASES

	Minimum	Maximum	Average
Pre-operative	6000	12000	9000
Postoperative	12000	25000	18000
Jump	3000	14000	9000

TABLE VI. GROUP 3. PELVIC FLOOR AND DILATATION AND CURETTAGE. 5 CASES

	Minimum	Maximum	Average
Pre-operative	8000	12000	10000
Postoperative	17000	26000	22000
Jump	5000	18000	10000

TABLE VII. GROUP 4 DILATATION AND CURETTAGE, STEM PESSARY, CERVICAL POLYP. 2 CASES

	Minimum	Maximum	Average
Pre-operative	7000	10000	8500
Postoperative	14000	15000	14500
Jump	5000	7000	6000

TABLE VIII. AVERAGES, GROUPS 1, 2, 3, 4

	Pre-operative	Postoperative	Jump
Group 1	10000	20000	10000
Group 2	9000	18000	9000
Group 3	10000	22000	10000
Group 4	8500	14500	6000

By time:

Group 5. 30 min. 2 cases. These are the same cases as in Group 4 above.

Group 6. Under 1 hour. 6 cases. Table IX.

Group 7. 1 to 2 hours. 21 cases. Table X.

Group 8. Over 2 hours. 1 case.

TABLE IX. UNDER 1 HOUR. 6 CASES

	Minimum	Maximum	Average
Pre-operative	8000	12000	10000
Postoperative	15000	25000	19000
Jump	5000	14000	8000

TABLE X. GROUP 7. 1 TO 2 HOURS. 21 CASES

	Minimum	Maximum	Average
Pre-operative	6000	13000	9000
Postoperative	12000	27000	19000
Jump	4000	19000	10000

TABLE XI. AVERAGES, GROUPS 6 AND 7

	Pre-operative	Postoperative	Jump
Group 6	10000	19000	8000
Group 7	9000	19000	10000

We can see no significant difference between the groups. Therefore, barring our two short cases with very slight trauma, we find no significant difference in the other operations, as to duration or type of operation.

Having seen from Series I that there was a fairly constant postoperative leucocyte curve during the first week, we were interested to know when the peak of the leucocytosis occurred. From Figure I, one would infer that the peak was one day after operation. In order to investigate this, 9 cases were studied in detail.

Series II

METHOD

Blood counts were done on the day preceding operation, and at 11:30 a.m., and 1:30 p.m., of the day of operation. The operation occurred from 2:30 to 4:30 p.m. A count was then done one hour after operation and every 3 hours thereafter during the night. During this period, the patients were kept in the recovery room. The same methods were used as in Series I. Temperatures were taken every 4 hours, routinely, by the nurse.

OBSERVATIONS

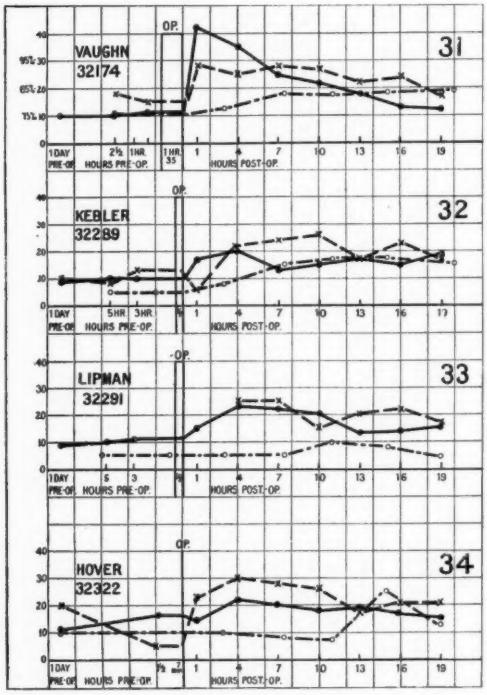
Charts 31 to 39 inclusive show the results, charted in hours after operation, while charts 31a, 32a, 33a, show the curves as charted according to scale used in Series I.

In two cases, 31 and 39, there was a very high leucocytosis one hour after operation, followed by a gradual fall. In the other cases, the peak came at the fourth hour count.

The percentage of polynuclears varied in general with the leucocytosis, rising to a peak, in the majority of cases, around the fourth hour, and in all cases the peak was reached by the tenth hour.

There is, however, no close association between total leucocytes and percentage of polynuclears.

The temperature, as may be observed from the charts, does not rise synchronously with the leucocytes. In no case was the peak reached before the seventh hour after operation.



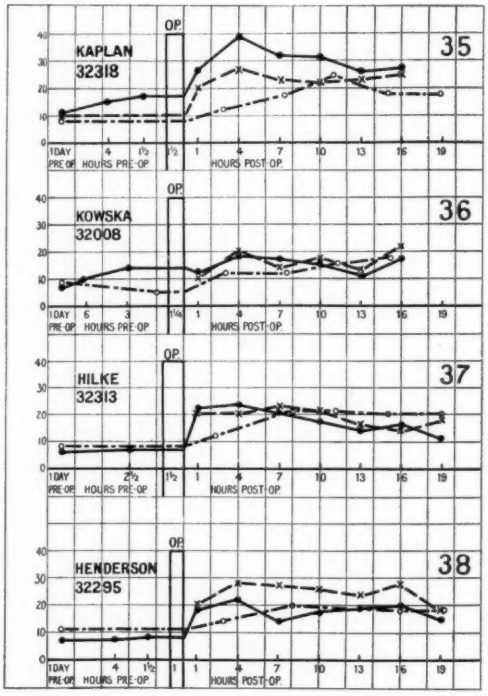
Charts 31–34. Series of hourly postoperative blood counts. Total leucocyte count ————; per cent polynuclears — — — —; temperature degrees Fahrenheit — · — · — · —.

Fig. 31. The operation performed consisted in a panhysterectomy, salpingo-oophorectomy bilateral, separation of adhesions, appendectomy. The time consumed was 1 hour, 35 minutes.

Fig. 32. The operation consisted in a Kelly stitch (for incontinence) and perineorrhaphy. The time consumed was 35 minutes.

Fig. 33. Operation: Kelly for retroversion. Time: 34 minutes.

Fig. 34. Operation: dilatation and curettage. Time: 7 minutes.



Charts 35–38. Series of hourly postoperative blood counts. Total leucocyte count ————; per cent polynuclears — — — —; temperature degrees Fahrenheit — · — · — · —.

Fig. 35. Operation: dilatation and curettage, Kelly stitch, cystopexy, lacerated pelvic floor. Time: 1 hour, 23 minutes.

Fig. 36. Operation: Resection left ovary puncture of m. cyst, (1) tube and ovary, suspension ovaries; (2) separation adhesions, appendectomy. Time: 1 hour, 19 minutes.

Fig. 37. Simpson retroversion, Noble shortening of uterosacral ligament, separation adhesions, appendectomy. Time: 1 hour, 30 minutes.

Fig. 38. Operation: Lacerated pelvic floor, cystocele, rectopexy, Kelly stitch, cervical polyp. Time: 1 hour.

TABLE XII. SERIES II GROUPED BY LENGTH OF OPERATION

Time hours	Jump		
	Minimum	Maximum	Average
0.75	6000	12000	9000
1.5	4000	31000	27000

Table XII shows the variation by time and it is observed that the 1.5 hour group has a much greater rise than the shorter group.

There is some variation with the type of operation also, if one divides them as in Series I. However it seems too slight to classify in so short a series.

DISCUSSION

TABLE XIII. SERIES II IN DETAIL

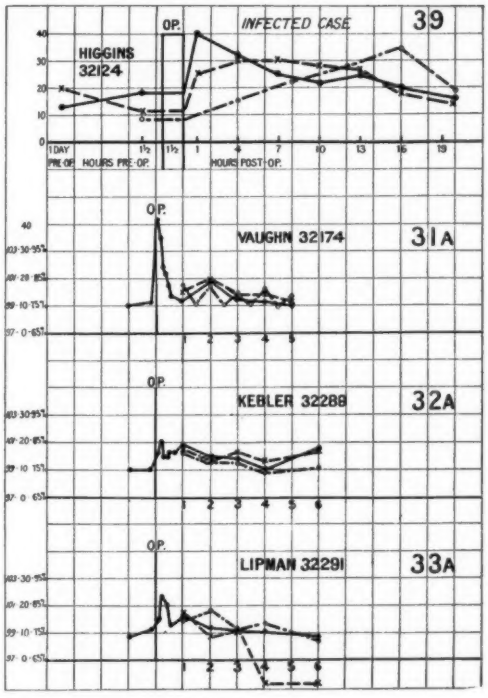
Case No.	Pre-operative	Peak postoperative	Jump	Hour of peak	Operation		
					Ounces ether	Time hours	Procedure*
31	11000	42000	31000	1	8.5	1.5	L
32	10000	20000	10000	4	5.0	1.5	P-F
33	11000	23000	12000	4	5.25	0.5	L
34	16000	22000	6000	4	Gas	7 min.	D-C
35	16000	39000	23000	4	7.5	1.5	P-F
36	14000	18000	4000	4	Gas	1.5	L
37	6000	23000	17000	4	5.5	1.5	L
38	8000	22000	14000	4	5.5	1.0	P-F
39	17000	40000	23000	1	9.5	1.5	L

*L means laparotomy, P-F pelvic floor operation, D-C dilatation, curettage.

There are many factors which make this study interesting. The time element, associated with a comparable degree of trauma, is shown here as a deciding factor much more definitely than in Series I.

In the two cases which had a low jump of 4,000 and 6,000, respectively, no ether was used; while the remaining seven received from 5.5 to 9.5 ounces of ether. It would seem, therefore, that ether might be a stimulating factor.

Concentration of the blood due to pre-operative preparation, and postoperative sweating, vomiting, and absence of fluid intake, etc., has been urged as a contributing factor (DaCosta). The counts of Series II would



Series of Hourly Post-operative Blood Counts

Charts 39, 31a-33a. Series of hourly postoperative blood counts. Total leucocyte count ————; per cent polynuclears — — — —; temperature degrees Fahrenheit — · — · — · —.

Fig. 39. Operation: Appendectomy, enterorrhaphy, Adhesions. Time: 1 hour, 35 minutes.

Fig. 31A. Operation: Pan-hysterectomy, salpingo-oophorectomy bilateral, separation of adhesions, appendectomy. Time: 1 hour, 35 minutes.

Fig. 32A. Operation: Kelly stitch (incontinence), perineorrhaphy. Time: 35 minutes.

Fig. 33A. Operation: Kelly for retroversion. Time: 34 minutes.

seem to point to this only as a minor factor since the counts 1 day pre-operative, and one hour pre-operative show a maximum of 5,000 rise in 2 cases and a usual rise of 1,000. Case 39 was not included in this for the rise before operation was due to a vaginal examination stirring up an infected condition. Similar rises had occurred following each vaginal examination. Very little work seems to have been done on the concentration of adult blood, but Bakwin and Morris (1) working on dehydration fever in infants, observed an in-

creased concentration of blood plasma associated with fever, but no corresponding leucocytosis. However, it seems apparent that an average rise of over 100 per cent could not be due to concentration, since such concentration (to one half volume), does not occur even in the most severe diarrhœas.

It is of interest to note the lack of association between the temperature and leucocytosis. In all cases the rise in white cells occurred by the fourth hour, and in the temperature after the seventh hour.

It is also of interest to note that case 39, with a history of appendiceal and pelvic abscess of 1 month's duration, cannot be distinguished at this period from the clean cases. Meleney found that infection had nothing to do with the initial rise but that on the second to third day after operation, it delayed the fall.

Some authors report a rise following the administration of morphine. Bohland (2) reports an increase from 6,386 to 13,832, 6 hours after 0.01 gram of morphine with a return to 7,805, 9 hours after the drug was given. Leake (9) presents 4 cases with a leucopænia 1 hour after administration followed by a pronounced leucocytosis lasting 10 hours, with a relative increase in the percentage of polynuclears. In the present series all patients received morphine about 4 hours after operation and then pro re nata during the night, and no attempt can be made to correlate these factors. However, the question is of interest.

We realize that 9 cases is too small a number from which to draw conclusions, but we believe that these data point the way to other study of much interest.

SUMMARY

A series of 30 cases was studied every day after operation to show the general leucocyte curve for a week. A series of 9 cases was studied in greater detail to determine the exact form of the curve immediately after operation.

CONCLUSIONS

1. There is a leucocytosis following operation which reaches its height by the fourth hour after operation, and returns to normal by the fifth day.

2. We are led to believe that the height of the peak varies directly with the duration of operation and extent of associated trauma produced, other factors being negligible.

3. The leucocytosis seems to be mainly a polynucleosis, the average of which compares grossly with the average total leucocyte count.

4. The temperature does not rise synchronously with the leucocytes but reaches its height several hours later. The average curve then remains grossly parallel with the leucocyte curve, but inasmuch as the temperature and leucocyte curves are not parallel in individual cases, one cannot assume that a certain temperature is constantly associated with a certain leucocytosis.

5. A further study of a larger series is necessary to correlate the various factors involved in this leucocytosis.

BIBLIOGRAPHY

1. Bakwin, H., and Morris, R. Leucocytosis in Dehydration Fever, in print.
2. Bohland. A study of the leucocytic effects of pyretics and anti-pyretics. Centralbl. f. inn. Med., 1899, xx, 361.
3. Cabot, R. C., Blake, F. B., and Hubbard, J. C. Studies of the blood in its relation to surgical diagnosis. Ann. Surg., 1901, xxxiv, 360.
4. DaCosta, J. C. Investigations of the action of ether upon the blood. Med. News, 1895, March 2.
5. DaCosta, J. C., and Kalteyer, F. J. Blood changes induced by the administration of ether as an anæsthetic. Ann. Surg., 1901, xxxiv, 329.
6. Fish, Hamilton. The importance of blood examinations in reference to general anæsthetization and operative procedures. Ann. Surg., 1899, July.
7. Gibson, C. L. The value of the differential leucocyte count in acute surgical diseases. Ann. Surg., 1906, April.
8. Gray, H. Cell counting technic, a study of priority. Am. J. M. Sc., 1921, clxii, 526.
9. Leake, C. D. Leucocytic reactions to morphine. J. Am. M. Ass., 1922, lxxviii, 1687.
10. Meleney, F. L. A study of ante-operative and post-operative blood counts in non-infective surgical conditions. Ann. Surg., 1918, lxvii, 129.
11. Romani, A. The leucocyte count after operations and trauma. Riforma med., Naples, 1922, xxxviii, no. 1; Abstracted, J. Am. M. Ass., 1922, lxxviii, 929.
12. Scott, R. A. Leucocytosis following gynecological operations. Surg., Gynec. & Obst., 1922, xxxv, 181.
13. Schilling, V. Value of the clinical blood picture. Deutsche med. Wchnschr., Berl., Abstracted, J. Am. M. Ass., 1921, lxxvii, 977.
14. Thro, W. C. Personal Communication from the Dept. Clinical Pathology, Cornell University Medical College.

CONGENITAL ABSENCE OF THE UTERUS AND ASSOCIATED DEVELOPMENTAL DEFECTS

Report of a Case[1]

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THE factors which make the study of this case of particular interest are the association of marked embryological abnormalities of the female genitalia with other developmental defects and tumor formation and the rather unusual opportunity of making a complete histological examination of these structures. This syndrome opens up at once the entire question of the etiology of congenital abnormalities of the uterus.

THE HISTORY OF THE CASE

The patient (Gynecological No. 27095) was a colored woman 30 years of age who was admitted to the Johns Hopkins Hospital complaining of an abdominal tumor. The general history was negative.

She stated that she began to menstruate at the age of 16, that her menses had always been very scanty, never amounting to more than a mere bloody stain which lasted for only a day or two and never associated with any pain. Her menses had always been irregular and infrequent, appearing at intervals varying in length from 3 months to a year. She had frequently had nose bleed, both with and without her menstrual periods, but never associated with any menstrual molimina. Although she had been married 9 years, she had never been pregnant.

The abdominal tumor was first noticed by her 4 months before her admission to the hospital. It had developed painlessly and without producing any changes in her menstrual periods. The patient was apparently normal in her sexual desires and satisfactions.

On examination, the patient was well developed and in excellent health. The secondary sex characteristics were normal. There was no tendency toward obesity.

The contour of the lower abdomen was irregular because of the presence of a round, hard, freely movable and insensitive tumor which filled the pelvis and extended to within 5 centimeters of the umbilicus. On pelvic examination, one immediately noticed that the vaginal mucosa was markedly redundant, protruding in the form of a red hyperæmic ring surrounding the vaginal orifice, as if there were a moderate grade of vaginal prolapsus. The mucous membrane bled very easily on touch, was thickened, freely movable on the underlying tissues and did not present any evidence of infection. The labia majora and minora, the urethra, and the clitoris were normal. The hymen could not be found.

The lower third of the vagina was of normal caliber and shape; it ended abruptly, however, 2.5 centimeters above the external orifice in a smooth vault which presented no opening whatever. There was no cervix. On bimanual palpation the pelvis was found to contain several masses which seemed to be connected directly with the large abdominal tumor. Before operation it was our impression that the patient had a congenital uterine abnormality associated either with myomata or hæmatometra.

At operation, the abdomen was carefully explored and these abnormalities investigated. The umbilicus, the gastro-intestinal tract, the kidneys, ureters, bladder and ovaries were normal. The lower abdomen and pelvis were to a large extent occupied by a round tumor which had all the gross characteristics of a fibromyoma of the uterus. This tumor, which measured 13 centimeters in diameter, was attached by a short pedicle immediately behind and lateral to the right round ligament. After this tumor had been delivered from the abdomen, one could see the remaining pelvic structures. The uterus was absent, but in the situation usually occupied by it there was a heavy fibromuscular septum which stretched across the pelvis continuous with the broad ligaments and suspended by the round ligaments. Over the lower third of its anterior surface lay the bladder; elsewhere it was covered by peritoneum. Its posterior surface led down to the cul-de-sac of Douglas. The rectum was normal. The round ligaments were moderately hypertrophied, measuring 7 millimeters in diameter, and were attached to the upper anterior angles of this ligamentous structure at points 7.5 centimeters apart from each other. The utero-ovarian ligaments were also unusually thick and were attached about 1 centimeter behind and lateral to the insertions of the round ligaments on each side.

The fallopian tubes were markedly rudimentary, their fimbriæ were closed. Their free portions measured 2 millimeters in diameter. The left fallopian tube was 2.5 centimeters long and terminated mesially in a solid bulbous enlargement 1 centimeter in diameter which was buried in the tissues between the insertions of the round and utero-ovarian ligaments. The right fallopian tube was 5.5 centimeters long. Two centimeters from its distal extremity it presented a cystic globular dilatation 3 centimeters in diameter, containing old blood—a typical hæmatosalpinx. Mesially to the

[1] Read before the Johns Hopkins Medical Society, March 3, 1924.

hæmatosalpinx the tube constricted again and terminated almost immediately in a firm fusiform body (1.25 centimeters by 0.7 centimeter by 0.8 centimeter), to which were attached the right round and utero-ovarian ligaments and the pedicle of the large fibroid. This nodule at the mesial end of the right tube was so small and so concealed that it might easily have been overlooked. It contained, however, a definite cavity 1.5 millimeters in diameter which connected with the right fallopian tube and was lined by endometrium,—the only trace of endometrium which was found in the entire pelvis. The remains of the wolffian ducts (the para-oophoron and epoophoron) were present in the broad ligaments without manifesting any unusual characteristics. There was a tiny hydatid of Morgagni, 1 millimeter in diameter, attached to the free border of the left mesosalpinx by a thread-like pedicle 1 millimeter long.

The entire congenital abnormality, the tumor masses, the rudimentary tubes, and the upper part of the ligamentous structure which separated the bladder from the rectum were removed by a block dissection (Fig. 1). As the ovaries were normal, they were not disturbed. In making the dissection between the broad ligaments, no further sign of a uterine cavity or fundus was encountered. After an uninterrupted convalescence of 15 days, the patient left the hospital in excellent condition.

Microscopic pathology. On microscopic examination, the tumors were found to be myomata and presented no unusual characteristics. A mild chronic inflammatory reaction was present in the wall of the right tube, its lumen was dilated, and most of the epithelial tufts were flattened out, these changes being due to the hæmatosalpinx. The left tube was solid, consisting of loose connective tissue and strands of smooth muscle in irregular arrangement. Scattered irregularly throughout the entire cross-section of the tube were numerous small islands of cylindrical epithelium, showing no connection with each other and no continuity of lumen. There was no round cell infiltration and no stroma. The bulbous enlargement at the mesial end of the left tube consisted entirely of smooth muscle and connective tissue in a loose and irregular arrangement with no trace of endometrium.

Endometrium was found only in the bulbous enlargement at the end of the right fallopian tube (Fig. 2). This structure had the essential microscopic elements of the adult fundus uteri. Its wall consisted of smooth muscle in regular pattern; the uterine cavity measured 3 millimeters long and 1.5 millimeters wide; the endometrium was normal, presenting the typical picture of premenstrual hypertrophy. Uterine glands and stroma, however, were scattered in islands throughout the entire wall of this rudimentary uterus.

INTERPRETATION

On the basis of these findings, I have interpreted this case as being one of complete non-union of the muellerian ducts. The fact that the fallopian tubes seemed to terminate definitely in bulbs which were clearly separated from each other, that one of these bulbs contained a tiny uterine cavity lined by normal endometrium, and that there were no other structures in the pelvis which in any way resembled the uterus, cervix, or tubes,—these data point to this conclusion. The myomata were clustered around the small nodes at the ends of the muellerian ducts and in that sense were myomata uteri. The tinge of menstrual blood which the patient noticed at rare intervals might have come from the hyperæmic and redundant vaginal mucosa.

The origin of the fibromuscular septum which separated the muellerian ducts and stretched across the pelvis between the bladder and rectum is an interesting and difficult problem—interesting, because it may involve factors which are concerned with the normal union of the muellerian ducts; and difficult, because of our ignorance concerning them.

When one first approaches the study of congenital abnormalities of the uterus, there seems to be no tangible means of comprehending them. The many different forms that uterine anomalies assume and the frequent absence of any common associated embryological defects which might furnish a clue concerning their mode of production, are factors that confuse one who attempts to unravel the etiology.

Purely clinical studies have apparently not led us far in understanding this problem. Congenital abnormalities of the uterus frequently cause no symptoms whatever; a few of the more extreme types produce sterility and menstrual irregularities. It is for relief from symptoms due to conditions which are quite incidental that most patients with uterine malformations seek professional advice. Hence it seems probable that in many instances, uncomplicated uterine malformations remain undetected. Moreover, very little practical reward can be offered to the patient for submitting to a complete study of such a condition, for after all, rarely is it possible to remedy the fundamental defect or give any marked relief. In most instances, therefore, when the diagnosis of a congenital

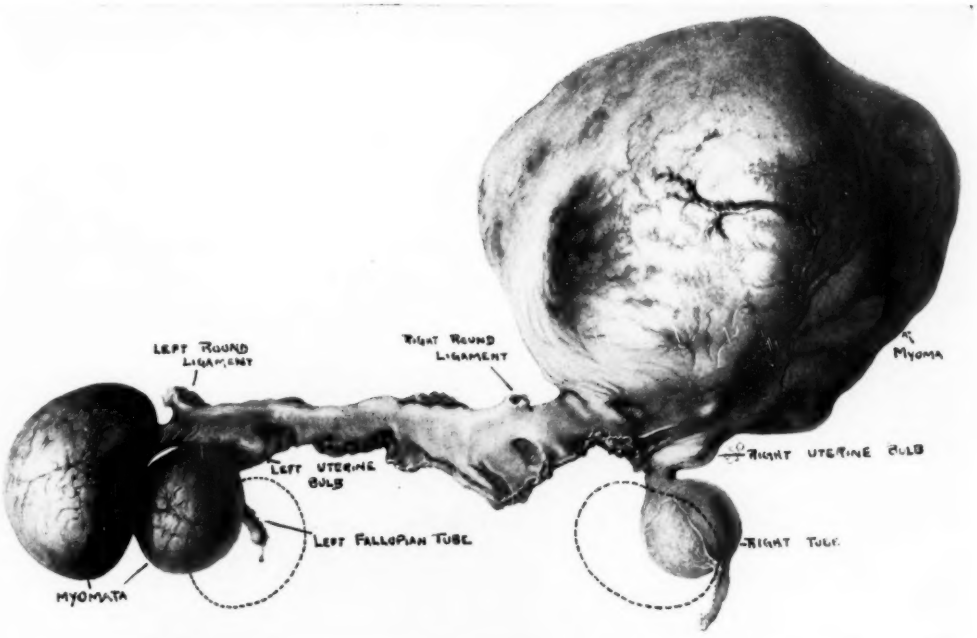

Fig. 1. The congenital anomaly, specimen removed at operation. Complete non-union of the muellerian ducts, absence of uterus, rudimentary closed fallopian tubes, right hæmatosalpinx, diminutive uterine bulbs at median ends of tubes, with septum between bladder and rectum. Multiple myomata clustered around uterine bulbs. Position of ovaries indicated by dotted circles; being normal, they were not removed.

abnormality of the uterus is established, the investigation ceases and the patient is dismissed. Because of these reasons, clinical records dealing with uterine malformations are incomplete and have not yielded us much information concerning the fundamental problems that are involved.

Nor can pathologists render us much assistance in this study, for congenital abnormalities of the uterus are not frequently a cause of death.

This problem must, therefore, be attacked from another angle. Consequently, I have attempted to study this question from the viewpoint of the lesions that are associated with congenital malformations of the uterus in the hope that thereby I might find a clue pointing to their etiology, or at least a rational basis for studying them. Fortunately, the clinical, pathological, and embryological data available are sufficient to make such an effort worth while.

CONGENITAL ANOMALIES LIMITED TO THE GENITO-URINARY TRACT

It has long been known that uterine malformations are at times accompanied by congenital defects of the kidney or ovary. The muellerian duct, kidney, and ovary have a common point of origin in the urogenital fold; developmental errors which are due to defects in this primordium are, therefore, likely to affect all the organs in the genito-urinary system.

When studied from this viewpoint, the uterus is not an isolated organ; on the contrary, it is only one of the component parts of the genito-urinary system. The importance of maintaining this point of view in studying diseases of the pelvic organs in women has been repeatedly emphasized by clinicians, pathologists, and embryologists.

In 1923, Eismayer collected from the literature 122 cases of absence of one kidney which were associated with malformation of the

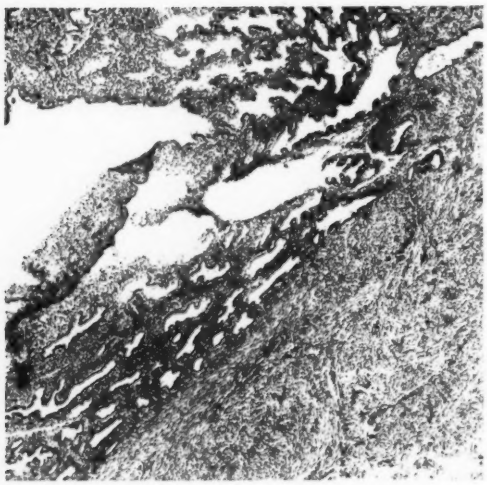

Fig. 2. Right uterine bulb, cross section. Low power magnification, showing normal uterine muscle, normal endometrium and uterine cavity which measured 3 mm. long and 1.5 mm. wide.

uterus. After having made a similar investigation, Holzbach came to the conclusion that a cystoscopic examination should always be made on patients with congenital lesions of the female reproductive organs in order to determine the condition of the urinary tract. In 1911, Guizzetti and Pariset published their study of the relation between the developmental anomalies of the urinary and reproductive organs in men and women, collecting their material from 20,000 consecutive autopsies at the University of Parma. In summary, they found that 66⅔ per cent of their cases of absence of one kidney presented developmental defects in the female pelvic organs; in most of these, there was a homolateral defect in the muellerian duct. Ballowitz, also, in 71 cases of congenital absence of one kidney found 41 instances of malformation of the female reproductive organs.

These accurate clinical and pathological studies impress upon us the advantage that would accrue if in cases of uterine malformation we always made a complete examination of all the genito-urinary organs. In practical application, it means that a study of a patient with a malformation of either the reproductive or urinary organs is fundamentally incomplete unless the investigation includes the whole genito-urinary system, for, to quote Keibel and Mall, "the urinary and reproductive organs form an inseparable whole in the adult organism."

UTERINE ABNORMALITIES ASSOCIATED WITH EXTRA-UROGENITAL MALFORMATION

In the case that I have presented the genito-urinary lesion was apparently limited to the muellerian ducts. There seems to be no proof that myomata can produce non-union of these ducts. The only other demonstrable anomaly was the unusual transverse band that stretched across the pelvis between the rectum and bladder. This band is a structure altogether foreign to the normal adult pelvis; if we could determine its origin, we might thereby obtain information concerning other factors that may be associated with non-union of the muellerian ducts.

In their early development, the fallopian tubes, uterus, and vagina are directly associated with the formation of the pelvis, the abdominal wall, the rectum, sigmoid, bladder, and urethra. This conclusion, founded on embryological research, has been verified clinically by the frequency with which abnormalities of the uterus are associated with abdominal hernia, ectopic ovary, unusual proportions of the bony pelvis, exstrophy of the bladder, abnormalities of the sigmoid, rectum, and anus, atresia ani, vulvovaginal anus, and congenital fistulæ due to incomplete development of the hollow pelvic viscera.

A careful analysis of the nature of these various associated anomalies reveals the fact that most of them can be traced to two sources: the cloaca and the parietes enclosing the lower part of the body cavity. Occasionally also defects are encountered in organs which are quite remote, the extremities and the palate. We shall pay particular attention to the association between defects of the cloaca and the muellerian ducts.

CLOACAL MALFORMATIONS AND THE MUELLERIAN DUCTS

Exstrophy of the bladder. This condition which is apparently due to an extroversion of a part of the cloaca, is frequently associated

with non-union of the muellerian ducts. In the British Museum are six specimens of simple exstrophy of the bladder (not associated with Meckel's diverticulum or intestinal fistula); in 2 of these 6 cases, the muellerian ducts extend to the exstrophied cloaca but do not unite, their orifices being separated by several centimeters. In the same museum are also five specimens of complicated exstrophy (in which the intestine opens on the exposed mucous membrane, associated with imperforate rectum and spina bifida); in all five of these specimens the muellerian ducts are completely separate, opening independently on the lower lateral quadrants of the exposed cloaca. Occasionally, the muellerian duct, the ureter, and the wolffian duct on each side unite in a common duct before they reach the cloaca. These specimens have been carefully studied by Arthur Keith.

Albert Doran, Sequeira, T. B. Johnston, and von Geldern have reported identical cases in fetuses at or near term. In some of these cases, as in mine, the mesial ends of the muellerian ducts terminated in bulbs containing a cavity lined by mucosa, the nature of which has not always been ascertained by microscopical study.

Undivided cloaca. Walker, Lynch, and Jerry have described instances in full term fetuses in which the cloaca presented no division whatever, and in these cases the muellerian ducts were completely separate, lying on each side of the cloaca.

Anal defects. Cases of vulvovaginal anus associated with non-union of the muellerian ducts have been described by Orthman, Bullard, and Strick; and cases of atresia ani by Eismayer, Guizzetti and Pariset.

It thus seems that there is an intimate relationship between the development of the cloaca and the uterus. The more extensive the cloacal inhibition, the more frequently it is associated with uterine malformation and the more complete is the non-union of the muellerian ducts.

THE CAUSES OF UTERINE MALFORMATION

Many theories have been advanced to explain the cause of non-union of the muellerian ducts. In Keibel and Mall's volumes on *Embryology*, Felix has discussed in detail many of them (fetal peritonitis, myomata, fetal hydronephrosis, etc.) all of which he regards as highly speculative.

It seems that any theories which are presented in explanation of this phenomenon must take into consideration not only the defective development of the uterus but also all associated anomalies, particularly those which are found in other organs of the genito-urinary system and in the cloaca.

In 1858 Krieger expressed the opinion that in some instances non-union of the muellerian ducts may be due to the mechanical obstruction presented by the undivided cloaca, and suggested that the transverse pelvic ligament found in some of these cases, as in mine, may be derived from the cloaca (the urorectal septum). This mechanical theory, attractive though it may seem, cannot elucidate the entire situation, for it does not explain those cases in which certain structures are wholly absent—the kidney, ovary or tube—and it does not assist us in understanding the etiology of defects that are more remote, such as spina bifida and hernia. It substitutes one unknown for another. In our opinion, Krieger's theory, even if confirmed, can be applied to only a limited extent.

The more intensively congenital defects have been studied, the farther back in embryonic life their incipiency has been traced. This has been brought out particularly by Hertwig and Stockard. Under experimental conditions, these observers have been able to produce anomalies and study their formative stages from the very beginning.

Hertwig's work was done in 1896 on tadpoles. Frog eggs develop into normal tadpoles in ordinary tap water; but by altering this medium by increasing its content of sodium chloride, Hertwig succeeded in producing spina bifida and anencephaly.

More recently, Stockard has confirmed the principle of Hertwig's experiments by artificially producing cyclopia in fish embryos (Fundulus heteroclitus) by increasing the amount of magnesium chloride in sea-water, which is the normal habitat of this species. Stockard found that if the eggs were placed in the magnesium chloride solution immedi-

ately after fertilization, 50 per cent of them developed cyclopia; if, however, this experiment was performed upon embryos that were more than 15 hours old, the eyes developed normally. In summarizing the work of Stockard, Mall stated in 1917 that there is no known instance of the formation of cyclopia by experimental methods after the eyes are fairly well formed in normal development. All the experiments in which cyclopia has been produced were made upon the embryo at a stage before the eyes could be recognized under the microscope.

These achievements demonstrate that these defects are caused not by inhibitions during later embryonic life, but by pathological changes induced in the primordial cells out of which these structures should form, and that these pathological changes have their incipiency during the earliest stages of structural formation.

Why should these changes affect only certain structures, leaving the rest of the embryo untouched?

In explanation of this question, the work of Sabin is very suggestive. While investigating the development of the circulatory system in the living chick embryo, she noticed that the growth of tissue is not continuous but occurs in definite cycles. In the embryonic circulatory system, she found that the complete growth cycle consists of two phases which succeed each other—a phase of nuclear division and cell multiplication followed by a phase of nuclear inactivity.

The onset of the phase of nuclear division is marked by a striking change in the appearance of the whole tissue; it becomes distinctly brilliant due to an increase in the refractility of the cytoplasm. About 1 hour after this, mitotic figures appear rapidly throughout the entire tissue and the nuclei divide; the actual process of nuclear division occupies not more than a few minutes, after which the cells themselves divide. After the completion of this phase, the tissue loses its refractility and brilliance, and enters the resting phase. During the resting phase the individual cells increase in size but not in number and nuclear figures are not found. The period of rest or equilibrium therefore is marked by an increase in the size of the tissue mass without any increase in the number of cells.

This cyclic method of growth Sabin has noticed not only in the vascular system but also in other structural units in the early chick embryo. She has watched the entire entoderm and also the central nervous system undergoing active cellular division. She has furthermore observed that these phases do not occur simultaneously throughout the entire embryo; on the contrary, while the cells in one embryonic organ may be undergoing division, those in another may be at rest.

Sabin, therefore, concludes that in the early stages of embryonic development, all the cells of a given tissue divide at approximately the same time, and that in different tissues the phases of cell division do not occur simultaneously. A somewhat similar periodicity of growth has been noticed in plant life, and Livingstone states that during periods of nuclear division, the cells of plants are much more sensitive to unfavorable changes in environment, temperature, and nutrition than they are while at rest.

It may be possible that in these principles of growth will be found some of the fundamental factors which play a part in the production of developmental aberrations and eventually we may be able to explain the localization of developmental abnormalities on this basis. Thus, if unfavorable environmental factors are brought to bear on the embryo, the cell groups that are in the active phase of mitosis and multiplication will be more susceptible to injury because during that stage they are particularly sensitive. On the contrary, embryonic structures, the cells of which are in the resting phase, may escape injury because of their greater resistance. It has been shown in tadpoles and fishes that if unfavorable factors become more marked, structural injury is followed by the death of the embryo. In this connection it is interesting to recall that Mall found that a large number of the embryos in miscarriages are deformed, thus showing that injury to local structural units had preceded death. In the case which I have presented it seems that the more highly specialized epithelial elements of the uterus were particularly involved.

The work of Hertwig, Stockard and Sabin has furnished us a new viewpoint, a new idea in the study of congenital malformations. Since developmental defects of the female genito-urinary system have not yet been studied experimentally in the light of these findings, it would be premature to attempt to formulate what the eventual application will show. Suffice it to say that a new field of research has been opened up, the clinical importance of which is far-reaching. The susceptibility of the ovum to injury during its early formative period has been demonstrated experimentally. Whatever may be the ultimate solution of these embryological problems, it seems evident that we must take a broader clinical view of the subject of malformations of the female genito-urinary system than we have in the past.

CONCLUSIONS

1. In making a clinical study of a case of congenital abnormality of the uterus, one must bear in mind that the genito-urinary organs have a common origin, and in their development are inseparably associated. Such malformations must, therefore, be studied from the viewpoint of the genito-urinary system as a whole.

2. Malformations of the uterus are occasionally associated with developmental defects of organs not in the genito-urinary system; such defects have been found most commonly in the abdominal wall, the bony pelvis, and the structures derived from the cloaca, i. e., the rectum, anus and bladder. A satisfactory explanation of these associations has not yet been made.

3. The experimental work of Hertwig and Stockard demonstrates that congenital defects have their incipiency farther back in embyronic life than we have heretofore supposed.

4. The findings of Sabin, Stockard, and Hertwig suggest some of the factors that may be directly concerned in the production of congenital malformations.

The author wishes to acknowledge his indebtedness to Dr. George L. Streeter, director of the Carnegie Institute of Embryology, and also to Dr. Florence R. Sabin, professor of histology. To Dr. Thomas S. Cullen the author also expresses his feeling of appreciation for advice that he has kindly given.

BIBLIOGRAPHY

BALLOWITZ, E. Arch. f. path. Anat. etc., 1895, cxli, 309.

BUSS, O. Zur Dystopie der Nieren mit Missbildungen der Geschlechtsorgane. Ztschr. f. klin. Med., 1899, xxxviii, 439–460.

BULLARD, J. W. Congenital absence of the uterus and anus, the rectum ending in the vagina. J. Am. M. Ass., 1898, xxxi, 479–480.

DORAN, ALBERT. Dissection of the genito-urinary organs in a case of fissure of the abdominal walls. J. Anat. & Physiol., 1881, xv, 226–234.

EISMAYER, GOTTFRIED. Ueber Uterusmissbildung bei kongenitalem Mangel einer Niere. Ztschr. f. urol. Chir., Berlin, 1923, xi, 191–220.

FELIX, W. The development of the urogenital organs, in Keibel and Mall, Manual of Human Embryology. 1912. Philadelphia: J. B. Lippincott Co., ii, 752–979.

GUIZZETTI, P., und PARISET, FABIO. Beziehungen zwischen Missbildungen der Nieren und der Geschlechtsorgane. Arch. f. path. Anat. u. Physiol. u. f. klin. Med., 1911, cciv, 372–392.

HOFMEIER. Demonstration einer Missbildung. Naturfors. Versamml. zu Stuttgart., lxxviii; also Monatschr. f. Geburtsh. u. Gynaek., 1906, xxiv, 535.

HERTWIG, O. Erzeugung Thierischer Missbildung. Festschr. f. Carl Gegenbaur, 1896, ii.

Idem. Beitraege zur Experiment. Morphologie und Entwicklungsgeschichte. Arch. f. mikrosk. Anat., xxxxiv.

JOHNSTON, T. B. Extroversion of the bladder, complicated by the presence of intestinal openings on the surface of the extroverted area. J. Anat. & Physiol., 1913, xlviii, 89–106.

JONES, FREDERICK WOOD. Extroversion of the bladder and some problems in connection with it. J. Anat. & Physiol., 1912, xlvi, 193–210.

KEITH, ARTHUR. Three demonstrations on malformations of the hind end of the body. Brit. M. J., 1908, ii, 1857.

KRIEGER. Monatschr. f. Geburtsh., 1858, xii, 179. Quoted by Alfred J. Ostheimer in Notes on the etiology of uterus bicornis, Am. J. Obst., 1902, xlv, 785–788, also quoted by Felix.

LEWIS, FREDERICK T. The development of the intestinal tract and respiratory organs, in Keibel and Mall, Manual of Human Embryology. Philadelphia: Lippincott, 1912, 291, 335.

LYNCH and JERRY. Dystocia due to ascites in a fetus with persistent cloaca; report of a case. Surg., Gynec. & Obst., 1916, xxii, 618–619.

MACKENZIE, F. S. On a specimen of the hindgut opening into a cloacal chamber in a child. J. Anat. & Physiol., 1906, xl, 409–411.

MALL, FRANKLIN P. Cyclopia in the human embryo. Contribution to Embryology. Carnegie Inst. of Washington, 1917, vi, No. 15, 7–34.

Idem. On the frequency of localized anomalies in human embryos and infants at birth. Am. J. Anat., Philadelphia, 1917, xxii, 49–92.

MCCANN, F. J. Some abnormalities of the female generative organs. Am. J. M. Sc., 1896, cxii, 393–400.

ORTHMANN, E. G. Foetale Peritonitis und Missbildung etc. Monatschr. f. Geburtsh. u. Gynaek., 1907, xxv, 302–319.

PERAKH, F. R. Absence of uterus, fallopian tubes, one ovary, and vagina, with one large central kidney. Brit. M. J., 1919, ii, 496.

PICK, L. Gebaermutterverdoppelung und Geschwulstbildung unter Berueckschtigung ihres aetiologischen

Zusammenhanges. Arch. f. Gynaek., 1896, lii, 389–409.

PICK, L. Zur Anatomie und Genese der doppelten Gebaermutter. Arch. f. Gynaek., 1898, lvii, 596–634.

REICHEL, PAUL. Die Entwicklung der Harnblase und Harnroehre. Wuerzburg, 1893.

Idem. Die Entwicklung des Dammes und ihre Bedeutung fur die Entstehung gewisser Missbildungen. Ztschr. f. Geburtsh. und Gynaek., 1888, xiv, 82–95.

RUSSELL, W. W. Aberrant portion of muellerian duct found in ovary. Johns Hopkins Hosp. Bull., 1899, x, 8–11.

SABIN, FLORENCE R. Studies on the origin of blood vessels and of red blood corpuscles as seen in the living blastoderm of chicks during the second day of incubation. Contribution to Embryology. Carnegie Inst. of Washington, 1920, ix, 213–262.

SEQUEIRA, J. H. A case of ectopia vesicæ, with patent vitelline duct. J. Anat. & Physiol., 1896, xxx, 362–368.

STIEDA, A. Ueber Atresia Ani Congenita und die damit verbundenen Missbildungen. Arch. f. klin. Chir., 1903, lxx, 555–583.

STOCKARD, CHARLES R. The influence of external factors, chemical and physical, on the development of fundulus heteroclitus. J. Exper. Zool., 1907, iv, 165–201.

Idem. The influence of alcohol and other anesthetics on embryonic development. Am. J. Anat., 1910, x, 369–392.

Idem. The artificial production of one-eyed monsters and other defects, which occur in nature, by the use of chemicals. Anat. Record, 1909, iii, 167–173.

STREETER, GEORGE L. Personal communication.

STRICK, E. J. A case of congenital absence of the uterus with anomalous vulvovaginal anus. Am. J. M. Sc., 1918, clvi, 75–78.

WALKER, CRANSTON. Ectopia cloacæ. J. Path. & Bacteriol., 1919, xxiii, 109–114.

FIRST DORSAL, SIMULATING CERVICAL RIB—BY MALDEVELOPMENT OR BY PRESSURE SYMPTOMS

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MR. H. F., aged 43, was referred to one of us in January, 1924, by Dr. L. Lesser, because of a bony-hard mass at the base of the neck on the right side which, however, had never produced any symptoms. No abnormality, vascular or neural, was elicited upon examination. Cervical rib was diagnosed, but a roentgenogram (Fig. 1) showed that the mass was a maldeveloped first (dorsal) rib bearing an articulation in its shaft.

Rib anomalies, as anatomical specimens, are by no means rare. In the mammalia all manner of rib variations, and more particularly variations of the first rib, have been described (1, 7, 13, 23). Almost every dissecting room and anatomical museum can produce a number of such variants from the normal. They were recognized in man as early as the second century by Galen. Among the moderns, Hunauld (8) in the eighteenth century directed his attention to this subject. These conditions can be of only morphological interest, however, unless, as in the case of cervical rib, they demand attention because of the symptoms they may occasion.

In the classic article of Gruber (6), and in the host of excellent publications on that subject in recent years, particularly since the advent of the X-ray, cervical rib has been amply discussed. But little consideration, however, has been given to the causation by the first dorsal rib of symptoms resembling those associated with cervical rib.

In quite recent years some excellent observations of this condition have appeared in the English literature but, apart from a few sporadically reported cases of nerve pressure due to *malformed* first dorsal rib, nothing has appeared in the American literature, and the production of nerve symptoms by a *normal* first rib appears not to have been observed in this country. Indeed, when Sir Harold Stiles gave a lecture-demonstration on "brachial neuritis due to pressure of the lowest trunk of the brachial plexus against the first rib" before the Clinical Congress of the American College of Surgeons in 1921 (unpublished), his communication was received with surprise.

During the latter part of the nineteenth century, the characteristic clinical syndrome was described by Buzzard, Charcot, Secretan and others (quoted by Buzzard, 4), but its

Fig. 1. Symptomless maldeveloped first (dorsal) rib, projecting in the neck like a cervical rib.

Fig. 2. Rudimentary cervical rib in a patient having pain in the arm and neck, beginning after exertion (golf) and relieved by elevating the shoulder.

significance was apparently not appreciated. These authors considered their cases as "uniradicular palsies of the brachial plexus" and did not even suggest the possible relation of the nerve to any rib pressure. In 1903 Bramwell (2) was, apparently, the first to suggest the association of these two in any sort of causal relationship. He reports the case of a plumber, aged 18, who complained of pain along the inner side of the arm with a loss of power and a sensation of coldness in the hand. Bramwell commented, "The pain is possibly suggestive of pressure on the roots. In this connection it is interesting to note the intimate relation of the first dorsal nerve root to the internal border of the first rib. Such a relation can hardly fail to predispose this root in an especial manner to traumatism."

As far as can be determined, it is to Keen (11) that credit belongs for having first definitely recognized and briefly described the production of symptoms by an abnormal first dorsal rib. In his article on cervical ribs, he reports 2 such cases in both of which "cervical rib" was diagnosed, though subsequent examination proved their absence:

In a female, aged 22, during the course of a general physical examination, "bilateral cervical ribs" were accidentally discovered. "A hard supraclavicular tumor on the left side, with a smaller, similar one upon the right" were found. X-ray examination showed no cervical rib. Neither in the subclavian artery on either side, nor in any of the branches below the subclavian could any pulsation be detected. Keen concluded that the mass was probably "the first dorsal rib more highly placed than usual."

In the second case, a male, aged 21, had first observed an enlargement of the neck 8 years previously. There were no symptoms until 4 months before, when the patient noticed a numbness of the left arm. Roentgenograms showed the cartilage of the first rib on the right side to be undergoing calcification. On the left side "the first rib instead of curving forward from the spine as does the right, changes its direction at its articulation with the transverse process and thence runs almost in a straight course downward and outward. The tip of it is lost at the point where the first rib and the clavicle cross each other." Neither of these two cases was operated upon.

Cases similar to those here mentioned in which an *abnormal* first dorsal rib simulated a cervical rib are few in number.

Russel (20) recorded the case of a woman, aged 31, who complained of shooting pains in the right hand and fingers and numbness in the left index finger. The illness was of 9 years' duration and had begun "with numbness in the right hand accompanied by alternating cyanosis and stone whiteness. Skiagraphs showed what was thought to be undeveloped first thoracic ribs." The woman refused operation but later committed suicide; and autopsy disclosed the right subclavian artery distal to the thyroid axis

contracted and cord-like for a distance of about 2½ inches. Microscopic section showed an obliterating endarteritis with a partly recanalized thrombus completely blocking the lumen. The vessel seemed to lie between the scaleni medius and anticus with the rib behind it. On the left side, beneath the clavicle the vessel was apparently partially thrombosed. As for the ribs, even at autopsy Russel was uncertain whether they were real cervical ribs, first dorsal ribs or a fusion of both.

Thorburn (25) reported the case of a female, aged 25, who had fallen from a bicycle and wrenched her arm. Her symptoms were aggravated by various slight traumata and by cold weather. Roentgenograms showed what appeared to be supernumerary ribs. Because of the increasing paralysis, and for the relief of pain, it was decided to operate. Thorburn wrote: "the specimen removed is most complete and closely resembles an imperfect first dorsal rib."

Hvoslef (9) recorded the case of a man of 21, who complained of a steady pain in the left elbow radiating to the forearm and hand. His hand at times became cold and pale and there was tingling in the fingers. A bony prominence was felt above the clavicle and X-ray examination showed "an abnormally developed first dorsal rib." At operation, "the end of the rib was found articulating with the upper, inner surface of the second rib, with the plexus resting on the top of this joint which with its capsule formed the bulk of the prominence felt above the clavicle before operation." Except for a slight paresis of the index finger and thumb, probably due to operation, the recovery was uneventful.

In 1913 Szawicki (24) reported a case of "first rib simulating cervical rib" in a Polish journal that is inaccessible.

Morley (16) added the case of a women, aged 42, who complained of long-standing pain localized to the area of distribution of the lower cervical cord which was made worse by carrying weights and relieved by elevating the arm in a sling or supporting it on the arm of a chair. Apart from wasting of the muscles of the hand the patient showed no symptoms. Upon excision of the first rib the symptoms disappeared.

In 1915 Outland (19) published a brief note concerning a patient with a "first rib anomaly simulating cervical rib." The patient had symptoms of erythromelalgia, numbness, tingling, easy disposition to pain on exposure to cold, and two prominent ribs in the lower cervical region which had seemed to be cervical ribs. The roentgenogram was reproduced because it "seems to be very similar to the only reported case in the literature, that of Hvoslef." Operation was not permitted.

And, finally, Clerc (5) reported the case of a soldier, aged 31, who was invalided for lancinating pains in the forearm and shoulder, augmented by exertion. At the age of 11 he had noticed a feeling of uneasiness in the left shoulder which, however, had not interfered with him until, in military service, he had to carry weights on this shoulder. He had a hard mass in the left supraclavicular region and various neurological signs. X-ray examination showed an osseous shaft passing from the vertebral column downward toward the clavicle, where it terminated. At operation an anomalous scalenus medius was found and a rib 5 centimeters long attached by a small band to the second rib and at its vertebral end to a muscle mass. Complete recovery followed its removal.

This series with *abnormal* rib formations constitutes one type of cases in which nerve symptoms due to first rib pressure are found. There is, however, another category of cases in which either no rib anomalies are found or the rib variations are purely incidental in significance.

Thus, Thomas Murphy (18) described the case of a woman, aged 28, who sought advice because of "pain, numbness, coldness, tenderness and loss of power in the left shoulder, arm, forearm and hand with swelling and dusky discoloration of the wrist and hand." The patient had had similar attacks during the preceding 8 years and had noticed that the symptoms were "worse after any exertion involving the use of the arms, such as typewriting or tennis playing." During the winter the symptoms were always present, whereas during the summer months they seemed to be brought on only by exertion. There was atrophy of the hand muscles and a slightly resistant area of tenderness in the supraclavicular fossa. The roentgen appearance was normal. At operation the tender area of resistance, giving the impression of a swelling, was found to consist of the insertion of the scalenus medius into the rib, with the nerve passing over it at that point. A large part of the first rib was removed and on the afternoon of the same day the color of the hand had become normal and within a week practically all the symptoms, even after exertion, had disappeared.

A somewhat similar, though more interesting case of Sir Harold Stiles' is reported by Bramwell (3). A masseuse, aged 28, 2 days after appendicectomy developed pain above the left clavicle and down the inner side of the left forearm. There were found atrophy of the intrinsic hand muscles with anæsthesia in the fingers to touch and pain, and tenderness above the left clavicle near the spine; however, no cervical rib was palpable. In spite of positive X-ray evidence of the presence of bilateral cervical ribs, Stiles decided that the symptoms were due not to the cervical but to pressure of the inner cord of the plexus against the first (dorsal) rib. A piece of apparently normal first rib was removed with complete subsidence of the symptoms.

Bramwell states that Stiles has operated upon several such cases with satisfactory results. Although Stiles himself has never pub-

lished the cases (personal communication) he has supplied a description of his operation for partial removal of the first rib (21).

In 1919 Stopford (22) reported a series of 10 cases studied by him and operated upon by Telford. These patients, all seen within a relatively short time, presented symptoms resembling those above noted, showed no evidence of any rib abnormality but were relieved by resection of the first rib. Of this series 2 are of especial interest:

A driver, blown up by a high explosive shell in July, 1916, was severely bruised about the shoulders. Seven weeks later he began to suffer from stiffness and loss of power in the right hand with pain in the shoulder that was aggravated when the limb was dependent and was relieved by supporting the shoulder. In May, 1917, the right shoulder was decidedly lower than the left. The first rib was removed with great amelioration of the symptoms.

A captain received a gunshot wound of the left shoulder causing a compound fracture of the clavicle. "The clavicle healed with considerable overriding of the fragments, so that there was great depression of the shoulder. As soon as the limb was allowed to be free from all bandages and support, he began to suffer from a dull, aching pain in the region of the left deltoid and at times a neuralgic pain along the inner border of the left forearm. There were associated atrophy of the muscles and sensory changes. . . . Within 4 to 6 weeks, under rhythmical faradic stimulation, muscle training and massage, there was definite improvement." At the end of 6 months the officer returned to duty.

Wheeler (28) reports the case of an athletic clergyman who had noticed gradually increasing loss of grasping power in the hand with moderate hyperæsthesia in the fingers (worse in the fourth and fifth than in the other three), increased by cold. He had also noticed that "the gripping power of the fingers depended greatly on the position of the arm. Above his head his power was increased and he could write on a blackboard steadily and with ease . . . grasping a cup of tea, on the other hand, was impossible." Roentgenogram showed no cervical rib. Treatment by ionization, massage, hot air, baths, etc., had been tried for several months without any lasting improvement. The first rib was resected. "The artery did not lie in direct contact with the rib but the nerve was tightly stretched like a band across the inner border of the rib."

There are, then, to repeat, two types of cases: first, the type which, with obvious deformity of the first rib, presents symptoms of nerve pressure and, second, the type which, without any apparent rib anomaly, gives exactly the same symptoms. We feel that despite the paucity of recorded cases, the condition merits attention, first, because of its resemblance to true cervical rib and the consequent difficulty in diagnosis, and, second, because doubtless many such cases with mild symptoms are either entirely overlooked or are misappreciated.

The symptoms that may be found in these two types of cases may be divided, in general, into three large groups: (a) local—tumor in the neck and tenderness at the site where the nerve crosses the rib; (b) vascular—coldness, pallor, or duskiness of the hands, occasionally an arterial bruit (in Russel's case, following the thrombosis of both subclavian arteries, the development of an extensive collateral circulation took place); (c) neural—disturbances of sensation, paræsthesias and dysæsthesias, loss of reflexes, loss of power in the arm, and atrophy of the intrinsic hand muscles.

While the number of cases is small in which accurate observations were made with a view to determining the exact anatomical and pathological relationships existing, a brief review of what has been observed may be of value.

The rib may show almost any type of anomalous variation. It may be rudimentary, as in Clerc's case. It may be jointed, as in the case here reported by us, or it may be entirely normal as in cases reported by Murphy, Bramwell, Stopford. It may possess exostoses (Maynard, 15). It may vary in position, being higher than normal, or in direction, as in the cases reported by Keen. Anatomical specimens of human rudimentary or jointed first rib have been reported by Lane (12), Helm (7), Leboucq (14) and others while similar deviations from the normal have been recorded in the whale, the cat, the horse, and others of the vertebrata by numerous authors. These variations in rib formation have been explained in many different ways. It has been claimed, for example, that they are to be considered as due to some fault in embryonic segmentation. Wiedersheim (29) looks upon this tendency to rudimentary rib formation as evidence of phylogenetic progress in the sense of a diminution of the thoracic cage, while jointed ribs and supernumerary ribs are to be "considered in the sense of a throw-back" to the condition seen in birds and some of the lower vertebrates in which there is a definite

division of the rib into a sternal and a vertebral portion.

In accord with this view, Leboucq (14) considers the first stage in the natural history of rudimentary ribs to be the development of an articulation between the ossa vertebro- and sterno-costales. At a later stage, the rudimentary rib is represented by a vertebral portion connected by a ligamentous band with the sternal portion. At a still later period even this band disappears and the result is the completely rudimentary rib.

Helm suggests that the articulation in the course of the rib may be regarded as a compensatory mechanism to provide sufficient respiratory excursions of the chest in cases of premature ossification of the cartilage of the first rib. Similar observations on the early ossification of the sternal ends of articulated ribs are reported by Leboucq.

Wood Jones (10), however, in a more mechanistic conception brings evidence to prove that "it is the nerves that are the dominant factor in shaping the destinies of the future ribs and this for the reason that the 'segmentation of the body finds its expression in the arrangement of the primitive segments and nerves supplying them and not in the skeleton, which is a later development' (Thomson)." Jones shows that rudimentary first ribs occur when the second dorsal nerve contributes to the formation of the brachial plexus, while cervical ribs are found when an unusually well developed first dorsal nerve contributes to the formation of the plexus. He shows, too, that the site of formation of the articulation in the rib is always to be found at the point where the nerve in passing out of the thorax grooves the uppermost rib, and that it is usually just mesial to the root that the outer extremity of the rudimentary rib terminates. He contends that the obliquity of the nerves occasioned by man's upright position largely, if not wholly, explains the loss of all but the usual number of ribs.

Wingate Todd (26), who has done a great deal of work in this and allied fields, accepts Jones' explanation with the emendation that "the costal anomalies at the upper end of the thorax are not due to any one cause. They are errors of segmentation or differences in bony tissue which are associated with the presence of variations in the disposition of the nerves and vessels in this situation." He concludes that the vascular, especially the arterial, influence is more marked on the left side and leads to: (1) fusion of the two uppermost ribs with the higher of the two becoming rudimentary, or (2) hindrance of the evolution of the rib toward bony tissue with the consequence that it is left as connective tissue in ligamentous form. Nerve influence, on the other hand, is equally marked on both sides and may lead to a portion of the rib being entirely inhibited and lying free at "one or the other extremity," as in Clerc's case.

Of all the theories here presented, those of Jones and Todd appear to be the most likely. Whether the nerves alone or in conjunction with vascular influences are to be held responsible for the various observed anomalies cannot be definitely stated. This much, however, may be said, that these explanations at least offer a dynamic conception of the formation of the various rib deformities.

As for the vessels little can be said since so few cases have been carefully studied anatomically. The subclavian vein, which appears to be but little involved in the production of the clinical symptoms, always is found lying anterior to the scalenus anticus muscle. The artery may, as in Russel's case, lie between the scaleni medius and anticus or, as in Clerc's case, it may lie entirely anterior to the scalenus anticus and thus be in no danger of pressure. In some of the cases studied actual thrombosis of the vessel may be the explanation of the vascular symptoms. But that similar symptoms may appear in a vessel which the subsequent course proves not to have been involved in any pathological process is shown by the case reported by Thomas Murphy where, following removal of the offending rib, all trouble disappeared almost immediately. Todd attempts to account for this by suggesting that the vascular symptoms are due rather to the effects of pressure on the sympathetic fibers found in the first dorsal nerve root than to direct compression of the vessel itself.

These theories, while interesting as affording an explanation of the pathological findings, are inadequate in that they do not explain the long

latent interval between the onset of symptoms and the time the anatomical peculiarities have admittedly existed, and they do not account for the frequent association of exertion with the development of clinical signs. John B. Murphy (17) in his article on cervical ribs laid great stress on the anatomical relationship of the scalenus anticus and the rib to the vessel and nerve. He believed that the vessel and nerve always pass over the rib behind the scalenus anticus, and drew the conclusion that the symptoms were caused either by the compression of the vessel and nerve between the rib and scalenus or, in the case of the artery, by an angulation of the vessel as it passed over the rib and then curved downward to the arm. Feeling the inadequacy of this hypothesis in the explanation of the latent interval, Keen modified this theory by assuming the development of some sort of endarterial pathological process, or some change in the relative position of the rib.

We feel that such an explanation can hardly account for the development of symptoms in cases such as those described by Bramwell, Thomas Murphy, or Stopford. We believe that the ultimate etiology is to be sought rather in a dynamic than in a static mechanism. Such an explanation, with a definite relation of the exciting moment to the onset of symptoms, has been offered by Todd (26). Stimulated by the report of T. Murphy's case, he began a series of observations on "the descent of the shoulder after birth." He calls attention to the fact that in the development of the arm bud, the axis of growth is at the level of the seventh cervical segment and that consequently the seventh cervical root should be the central and largest nerve root to the appendage. The eighth and ninth nerve roots must then course first upward to the level of the seventh root and then downward to their distribution in the arm. Any influence, therefore, that could cause tension on the eighth or ninth roots, which form the inner cord of the brachial plexus, would give rise to the symptoms observed with a cervical rib, or with a first dorsal simulating a cervical rib. We may say, then, that either an elevation of the rib relatively to the shoulder girdle, or a depression of the shoulder in relation to the rib, would satisfy the conditions necessary for the appearance of the symptoms here described. To determine the true state of affairs, Todd measured the angles of elevation from the horizontal of the rib and of the shoulder. He shows that in the normal development of the body there is a gradual descent of the shoulder. He shows, further, that the two extremities of the rib and the clavicle are operated upon by different forces which determine their relative positions. The outer end of the clavicle tends to move downward under the influence of the weight of the arm and the position of the manubrium. This downward force is counteracted by the influence of the shoulder-supporting muscles. The sternal ends of the clavicle and of the rib tend to move downward under the influence of the recti abdominis muscles acting on the manubrium. The vertebral end of the rib remains a fixed point. The outer end of the clavicle and the sternal end of the rib move independently, but under normal conditions "in the majority of cases . . . . the descent of the anterior end of the rib which also occurs between birth and adult age would neutralize the stretching effect of the descent of the shoulder on the nerve."

On the basis of such an explanation, the whole syndrome becomes rationalized. The local signs recede in importance and become merely accidental and incidental findings. The vascular symptoms are to be regarded in the light of effects of traction either on the sympathetic fibers contained in the first dorsal root (Todd) or on the subclavian artery itself against the rib; while the nerve symptoms appear to be the result of a longitudinal traction rather than of a transverse compression. The exertion or the trauma mentioned in the cases reported is to be looked upon as the exciting moment which by causing a loss of tone of the trapezius or an actual downward displacement of the shoulder leads to stretching of the nerve. On purely *a priori* grounds, it might be deduced that if the symptoms reported are, indeed, occasioned in this manner, then elevation of the shoulder mechanically or by muscle exercise, or the removal of a section of the offending rib should lead to an amelioration of the symptoms. That this explanation is most likely the correct one is shown by the

clinical histories of the reported cases. Russel states: "It was found that when the shoulder was elevated as by putting the left hand on the right shoulder the pain in the hand was alleviated. The patient stated that she always slept with her arm raised under her head thus elevating the shoulder." The case of the captain reported by Stopford is even more interesting in this respect. There the loss of the support afforded by his bandage brought on the symptoms while the regaining of the muscular tone of the trapezius through muscle training caused the cessation of symptoms.

This hypothesis affords not only a rational mechanism as an explanation of this condition but also a logical modus operandi for its treatment. Obviously the therapy will be (1) non-operative, and (2) operative.

On December 5, 1921, Mrs. Ada T., aged 45, was seen by one of us in consultation with Dr. M. Manges. For several years she had had pain in the left supraclavicular (trapezius) region, relieved by application of heat. In October, 1921, after active golfing, she had two attacks of pain in the anterior aspect of the left arm near the deltoid insertion, with some pain on motion. This arm pain had largely subsided but the pain in the neck continued, intermittently. It was relieved by recumbency, however, and disappeared during the night; the patient liked to sit in an armchair, for supporting the arm relieved the pain. There had been no sensory disturbances in forearm or hand; fingers did not become blue or swollen. The patient had been treated by two physicians with the diagnosis of subdeltoid bursitis, and she had also had treatment by diathermy, high frequency and the sinusoidal current, without relief. There were no atrophies or sensory changes; radial pulses equal in all positions of the arms; systolic blood pressure 110 in both arms; auscultation in the neck negative on both sides; no cervical rib palpable but pressure on the left side of the neck "made arm numb" and caused pain, while pressure on the right side caused neither pain nor numbness. Roentgenograms showed no subbursal lime deposit or other lesion in the shoulder but they did show on the affected side a quite rudimentary cervical rib, largely cartilaginous (Fig. 2).

It was advised that the patient carry a ribbon sling, and that she support her arm in it as much as possible. This gave considerable relief, and it was noted several months later that, with the use of this sling, the patient had had a fairly comfortable winter.

The above case, in which, however, a quite rudimentary cervical rib was present, is here recorded to illustrate the relief, without operation, that may be secured by elevation of the shoulder—an observation that has also been made by other authors. In discussing the question of non-operative treatment Stopford says that the non-traumatic cases can be much benefited by exercises designed to develop the trapezius, particularly the upper fibers, which function in the support of the shoulder girdle; while the traumatic cases respond very well to exercise, massage, and the judicious use of the faradic current. All cases, and particularly those in which for one reason or another operative intervention is contra-indicated, should be given a trial of support and muscle training. In cases in which, because of continued pain or of progressive nerve or vascular interference, no relief is seen in conservative measures, resection of the rib should not be delayed. The operative procedure has been well described by Stiles (21) and by Telford in Stopford's article.

REFERENCES

1. Adolphi. Morphol. Jahrb., 1899, xxvii.
2. Bramwell, Edwin. Rev. Neurol. & Psychiat., 1903, i, 299.
3. Idem. Edinburgh M. J., 1921, August, 65.
4. Buzzard, E. F. Brain, 1902, xxv, 299.
5. Clerc, A. Progrès méd., 1917, xxxii, 3 s., 131.
6. Gruber, W. Mém. Acad. d. sc. de St. Petersburg, 1869, xiii, No. 2.
7. Helm. Anat. Anz., 1895, x, No. 17.
8. Hunauld. Mém. de mathémat. et de phys. Acad. roy. d. sc., Par., 1742, 377.
9. Hvoslef, J. J. Minnesota St. M. Ass., 1911, xxxi, 251.
10. Jones, F. Wood. J. Anat. & Physiol., 1910, xliv. See also Proc. Roy. Soc. Med., 1913, vi, i, Clinical Section, p. 95.
11. Keen, W. W. Am. J. M. Sc., 1907, cxxxiii, 191.
12. Lane, W. Arbuthnot. J. Anat. & Physiol., 1885, xix, 256.
13. Leboucq, H. Ann. Soc. de méd. de Gand., 1885.
14. Idem. Arch. de biol., 1897, xv, 165.
15. Maynard. Des exostoses sus-claviculaires. Thèse pour le doctorat, Paris, 1884.
16. Morley, J. Clin. J., 1913, xlii, 461.
17. Murphy, John B. Surg., Gynec. & Obst., 1906, iii, 514.
18. Murphy, Thomas. Australian M. J., 1910, xv, 582.
19. Outland, J. Interstate M. J., 1915, xxii, 1100.
20. Russel, C. Med. Rec., 1907, lxxi, 253.
21. Stiles, Sir Harold. Contributed to Jones and Lovett's Orthopedic Surgery. New York: Wm. Wood & Co., 1923, pp. 549–551.
22. Stopford, John S. B., and Telford, E. B. Brit. J. Surg., 1919, vii, 168.
23. Struthers, J. J. Anat. & Physiol., 1875, ix, 17.
24. Szawicki. Prezegli. chir. i. ginik., 1913, viii, 195.
25. Thorburn, W. Med. Chron., 1907, xiv, 177.
26. Todd, J. Wingate. Anat. Anz., 1912, May 18, xli, 257.
27. Ibid. 1912, June 15, xli, 385.
28. Wheeler, Sir W. I. DeC. Practitioner, 1920, civ, 409.
29. Wiedersheim, R. Lehrbuch der vergleichenden Anatomie. Jena, 1886.

THE PLACE OF ELECTIVE VEIN LIGATION IN BLOOD-VESSEL SURGERY[1]

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IT is safe to say that previous to 1913 every surgeon considered that simultaneous ligation of a large vein and artery in the same extremity added greatly to the likelihood of ensuing gangrene. About 1913 Makins' (9) attention was attracted by the occurrence of gangrene in a large percentage of the cases of arteriovenous aneurism of the femoral artery in which proximal ligation was done, while excision of the aneurism and quadruple ligation was followed by good results.

In 1913 W. A. Oppel (11) published the results of several cases of popliteal vein ligation alone in cases of threatened gangrene of the foot. He was led to adopt this procedure from observations of the good results which occurred in some cases of arteriovenous anastomosis. These good results he believed to have been due almost wholly to the retarding of the venous return with a consequent rise in capillary blood pressure of the extremity.

Lidski (8) in the same year reported three threatened gangrene cases treated by vein ligation with satisfactory results in two.

In 1917 M. Van Kend (12) carried on some animal experiments at the Ocean Ambulance at LaPanne and presented the following observations to the Interallied conference of Surgeons held in Paris: "It appears then from the standpoint of the physiologist that to leave the main vein viable after occlusion of the main artery of a limb, diminishes what may be called the residuary blood pressure maintained by the collateral circulation. If the contribution of the collateral circulation is allowed to remain with the main vein intact, it is natural that the residuary blood pressure should fall. If this view be adopted, ligature of the vein as well as artery should be recommended in order to retain the blood supplied in longer contact with the tissues. Thus the most satisfactory conditions for maintenance of the nutrition of the organs are provided, because the obstacle to the return circulation provided by ligature of the vein retains the blood for a longer period in the member." Following Van Kend's remarks the following conclusion was adopted by the conference: "Contrary to what has until now been believed, simultaneous ligature of both artery and vein when both vessels have been wounded does not give rise to increased risks of gangrene; in fact it diminishes them. Facts tend to prove even when the wound is limited to the artery that simultaneous occlusion of the unwounded vein is to be recommended."

Hamilton Drummond (4) worked with loops of small intestines of cats and found the same principle to apply to intestinal vessels. Larger areas of gut became gangrenous where the artery alone was ligated than when both artery and accompanying vein were ligated.

At this point let us consider a few points in the physiology of the circulation. The vitality of a part depends upon its blood supply, and the blood supply to a given part depends upon the volume and character of the blood, the rate and propulsive power of the heart, the size and number of the supplying arteries, and the size and number of the returning veins. Metabolic activity of the tissues and the rhythmic contractions of the capillaries have a very important place in the stability of the blood supply.

When one or a number of arteries to a part are occluded, certain changes take place: (1) The amount of arterial blood to the part is lessened. The extent of the diminution will depend upon the number and completeness of the occlusion and the richness of the collateral circulation. (2) The tissues are deprived of their nutrition because the interchange of substances through capillaries is much reduced. (3) The capillary area is greatly diminished by a collapse of a large number of capillaries. (4) Rhythmic capillary contractions are probably little interfered with unless deprived of circulating fluid for a considerable period. (5) The venous return is altered only to the extent of the lessened pump action of de-

[1] This work was done in the Specializing Service of the Cook County Hospital. Read before the Chicago Surgical Society, March 6, 1924.

creased muscular activity. (6) The tidal flow is obviously much lessened and the residual blood materially reduced. (7) Intravascular pressure is decreased in the vessels distal to the occlusion.

Where one or more arteries are partially or completely occluded there necessarily occurs a marked disturbance in the circulatory equilibrium since blood is more readily carried away by the veins than it is supplied by the arteries. This increased capillary bed per unit volume of blood results in a marked decrease in intravascular pressure distal to the occlusion.

A certain minimum intravascular pressure must be maintained in the capillary area to prevent the permanent collapse of large capillary areas as well as to insure sufficient interchange of certain substances between the blood and the tissue cells.

Bier (1) has recently contributed a very interesting series of articles dealing with cell nutrition by venous and arterial blood. He states that one is led to believe that for tissue needs arterial blood is absolutely necessary and that venous blood acts detrimentally. If one has in mind the energetic metabolism connected with the function of organs or activity of muscles there can be little doubt of the need for an accelerated stream of arterial blood since the oxidation of organic substances is here the essential source of energy. Where the tissue needs are those required in preserving existing tissues, compensation for lost tissue ingredients, or in new-growths, the energy expended is so small per unit of time and the oxygen necessary to restore the chemical compounds so small that the most carbonated venous blood will fulfill the need. He concludes that one is better off with sufficient venous blood than with an insufficient amount of arterial blood. He also calls attention to the rarity of gangrene of the diabetic or senile type occurring in limbs with varicosities.

The ability of tissue to secure the proper amount of blood for its needs independent of the central nervous system or blood pressure, Bier calls, "das Blutgefuehl," or blood sentiment.

In 1923 Brooks and Martin undertook a series of experiments to establish a firm physiological basis for the simultaneous ligation of artery and vein. Their work consisted of a series of three experiments: (1) Experiments in which the effects on the temperature of the tissue distal to the ligature was studied; (2) experiments in which the blood pressure distal to the ligature was measured; (3) experiments to test the comparative frequencies of gangrene from simultaneous ligature of artery and vein, and ligature of the artery alone.

In their first series they found that ligation of the main artery lowered the temperature of the tissues and that simultaneous ligation of the vein still further lowered the temperature. In their second series it was demonstrated that intravascular pressure in both the arteries and veins of an extremity was decreased by ligature of the artery alone. If the artery was ligated and the intravascular pressure in both arteries and veins became constant at a level lower than normal, then obstruction of the vein resulted in a rise in intravascular pressure in both arteries and veins distal to the ligature. In their third series gangrene developed in 71.5 per cent of the animals in which the main artery was ligated. In animals where both artery and vein were ligated only 33.3 per cent developed gangrene.

They evidently do not believe as do Makins, Bier, and Horsley (5) that gangrene is less frequent after simultaneous ligation of the vein because such ligation results in a retention of blood in the tissues for a longer period. In their opinion, tissues require circulation of fluids and not stagnation to promote the interchange of substances between the blood and the tissue cells. They also point out that the simultaneous occlusion of the vein has been thought to bring about a wider distribution of blood. As a result of their experiments they leave one in doubt on this point since their experiments in which the temperature of the tissues was used as a criterion seems to contradict this theory.

Krough's (6) work on capillaries has thrown light upon some questions which confront those interested in this work. One very important observation seems to bear upon the rhythmical capillary contractions. It was found that under normal conditions

only part of the capillaries of a given area are open at one time and only under the stress of markedly increased tissue activity are all the capillaries open and even then there occur rhythmical contractions. Krough has also pointed out that capillary interchange of substances between blood and tissue cells is one of diffusion through a membrane rather than selective permeability, and that variations in capillary pressure have much to do with the rate of interchange between blood and tissue cells.

With the foregoing points set forth I believe we are safe in summarizing the known facts and assuming that our work along these lines will meet success or failure as we adhere to correct principles.

Simultaneous vein ligation must be so selected that it will serve only to restore circulatory equilibrium and must not result in too great a damming back of blood, lest ill effects of passive congestion outweigh the beneficial effects of increased capillary pressure. Here again Bier has pointed out that venous blood does become a source of trouble when the passive congestion exists over a long period and the venous blood becomes surcharged with tissue poisons.

Knowing the good effects which may be expected to follow vein ligation, one must also bear in mind that there is a certain lethal limit in the tidal flow of blood to an extremity or tissue.

The clinical application of the foregoing principles may be illustrated best by reviewing the results in some cases in which elective vein ligation has been done.

ARTERIOVENOUS ANEURISM

It was this particular group of cases that first attracted attention to the value of accompanying vein ligation. Callander (3) in his exhaustive study of arteriovenous fistula reported 27 cases treated by quadruple ligation with 21 cures or 77.7 per cent; 2 deaths or 7.4 per cent, and four instances of gangrene, or 14.8 per cent. These cases showed much better results than those treated by any other method tried.

I have had 8 cases[1] of arteriovenous aneurism in all of which a quadruple ligation has been done with 7 cures or 87.5 per cent; one death, or 12.5 per cent. The death occurred in a boy about 11 years of age who entered the hospital with an infected gunshot wound of the thigh. Following quadruple ligation, the severity of the infection necessitated amputation to try to save his life. Following the amputation infection spread to the buttocks and the patient died of sepsis some 2 weeks after admission. In 6 of the above cases the aneurism was femoral, in one axillary, and in one radial.

La Roque (7) has reported several cases of femoral arteriovenous aneurism treated by quadruple ligation with excellent results.

From the reported cases there can be little doubt of the efficacy of simultaneous vein ligation in arteriovenous aneursims.

PERIPHERAL ANEURISMS (NOT ARTERIOVENOUS)

In a previous article (10) I have referred to the use of vein ligation in false aneurisms and arterial hæmatomata.

In aneurisms of the extremities I have resorted to simultaneous vein ligation in 8 cases with cures in 6 cases; gangrene in one case; and one death. In this group there were four of the popliteal artery, one axillary, and three femoral. Three cases were not subjected to vein ligation. This group was made up of one femoral, one ulnar, and one axillary aneurism.

The results in the popliteal aneurisms I believe are worthy of comment. Three patients had simultaneous vein ligation and their courses were very satisfactory, with complete functional restoration of the extremity. The one unsuccessful case was in a debilitated man 68 years of age. Gangrene followed proximal and distal ligation of the artery, and death occurred as a result of a complicating pneumonia.

THREATENED GANGRENE

Cases of threatened gangrene in which there had been no response to medical treatment were selected. We undertook some of these cases with considerable reluctance, because we doubted whether the arterial blood supply was sufficient to warrant any operative proce-

[1] I have since had another arteriovenous aneurism of the femoral artery treated by quadruple ligation and obliteration—endo-aneurismorrhaphy—with excellent result.

dure. These operations, six in number, were done under local anæsthesia. In one the condition occurred in the upper extremity, in the others in the lower extremity.

In all the cases there occurred a noticeable decrease in pain and paræsthesias following the main vein ligation. The limb usually appeared to have a better color and the veins became more prominent. I have been able to follow several of the cases after discharge from the hospital. One parient is still in good condition and has had no return of pain in the extremity and shows no signs of impending gangrene at present. Of the others many seem to be returning to their pre-operative condition. Those arteriosclerotic affairs which are rapidly progressing to gangrene can be very little, if any, benefited. The milder cases unquestionably show considerable improvement for a time, and some seem permanently benefited.

ENDARTERITIS OBLITERANS AND RAYNAUD'S DISEASE

After a rather liberal number of failures to produce any appreciable change in endarteritis obliterans cases by the peri-arterial sympathectomy of Leriche, we conceived the idea of combining main vein ligation with sympathectomy. In most cases the feet became warmer, the cyanosis less marked, and the pain was often relieved. The superficial veins became prominent and gangrene seemed likely to be prevented. The results were transient and in a short time the cases progressed as did those not treated.

One case presented an unusual picture about 6 months following vein ligation. There was a marked dilatation of the superficial veins which became even more marked following a series of localized phlebitis attacks in these dilated superficial veins.

The failure to produce any permanent improvement in these cases is due, I believe, to the progressively diminishing tidal flow of blood to the tissues which is not improved by sympathectomy, and is little influenced by vein ligation.

COMMON CAROTID LIGATION

Much discussion has arisen from time to time over cases of cerebral changes following sudden occlusion of the common carotid artery. If, as many believe, its effects result from extending thrombus formation from the site of ligature toward the cerebrum, or embolism, then simultaneous vein ligation has nothing to recommend it. If it be due to anæmia, then a simultaneous ligation of the internal jugular on the same side should lessen the cerebral complications in these cases. Makins and Ceci report cases treated in this manner with good results.

CONCLUSIONS

1. Simultaneous vein ligation has a definite place in blood-vessel surgery.

2. One should be familiar with the principles governing the use of vein ligation before doing it, as harm may result if it is used in cases in which it is not indicated.

3. It probably has its greatest field of usefulness in cases in which the main artery is suddenly occluded.

BIBLIOGRAPHY

1. Bier, A. Muenchen. med. Wchnschr., 1923, January, 70–105.
2. Brooks, B., and Martin, K. A. J. Am. M. Ass., 1923, lxxx, 1678.
3. Callander, C. The Johns Hopkins Hosp. Rep., 1920, xlx, 260.
4. Drummond, H. Quoted from Makins' book.
5. Horsley, J. S., and Whitehead, R. H. J. Am. M. Ass., 1915, lxiv, 873.
6. Krough, A. The Anatomy and Physiology of Capillaries. Yale Univ. Press, 1922.
7. La Roque, G. P. Ann. Surg., 1921, lxxiii, No. 3, 265.
8. Lidski, A. T. Prakt. Wratsch., 1913, No. 7.
9. Makins, G. H. Gunshot Injuries to the Blood Vessels. New York: William Wood and Co., 1919.
10. McNealy, R. W. Illinois M. J., 1923, April.
11. Oppel, W. A. Zentralbl. f. Chir., 1913, No. 31, p. 1241.
12. Van Kend, M. Compt. rend., Conf. Chir. Interall. Paris, 1917, p. 348.

TUMOR OF THE LEFT GASSERIAN GANGLION

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THE operative finding of a tumor involving the gasserian ganglion is still of sufficient rarity to merit recording. The first case to be described in this country was an endothelioma of the Gasserian ganglion reported by Dercum, Keen and Spiller (11) in 1900, at a period when surgery of the ganglion was rarely attempted. During the next two decades tumors of this structure were reported in increasing numbers. In 1917 Sachs (55) in reporting an operated case summed up the literature in which he found 21 cases, 8 of which had been disclosed at operation. In the following year, Frazier (14) added 3 operated cases and gleaned from the literature 43 in all, 30 of which had been recorded at autopsy and thirteen at operation. In 1920 Cadwalader (4) added 1 autopsy report of an endothelioma and Cushing (9), from a series of 550 brain tumors, reported 8 cases in which the ganglion was affected, 5 of which were operated upon. In 1921 Shelden (57) reported 4 cases and in 1923 Parker (47) added 1 more disclosed at operation, making a total of 57 cases, of which 34 had been revealed at autopsy and 23 on the operating table. Of the 23 cases operated upon, in only 1, an endothelioma reported by Frazier (14), was the tumor completely removed, the patient remaining well after a period of 15 months. This patient was operated upon within 3 months of the initial symptom.

The following report is submitted as an example of a tumor which infiltrated the structure of the ganglion itself.

The patient, J. W. H., widower, 53 years of age, was referred by Drs. W. W. Roblee and W. H. Holmes of Riverside, California. He first came under observation on January 17, 1924, at which time he was complaining of pain in the region of the left ear and in the left side of the face. Four months previously he had lost a son, 18 years of age, from sarcoma of the jaw. Otherwise, there was nothing significant in the family or personal history. About 8 months ago, he first began to have a dull aching in and below the left ear and a feeling of fulness between the external auditory meatus and condyle of the jaw, but at no time was there any discharge from the ear. He also had a sense of fulness in the left submaxillary region which was probably the result of an enlarged cervical gland.

A few weeks after the onset of this pain he began to have discomfort in the left side of his face and mouth, the pain being confined principally to the second and third divisions of the trigeminal nerve. This pain was constant, grinding, and gradually increasing in severity and was worse at night. Several upper and lower molars were removed without relief. In view of the submaxillary swelling, the patient was referred to Dr. Rex Duncan of Los Angeles when it was noted there was an excess of lymphatic tissue at the base of the tongue and tonsil on the left side. A section of this was taken and from a microscopic examination a diagnosis of inflammatory tissue was made. He was given one deep X-ray treatment. Despite the above procedures his symptoms continued gradually becoming more severe. Later his tonsils were removed without relief. During the past 2 or 3 months the pain involved the first as well as the second and third trigeminal areas. He complained principally of pain in the temple and forehead on the left side although he was still aware of pain in the distribution of both the second and third divisions. He also stated that hearing on the left side was less acute than on the right and described a sound like "pounding" in the ear.

Examination on January 18 was generally negative except for the following points. There was slight fulness in the left submaxillary region where a small gland could be felt. He complained of moderate tenderness on pressure in front of the mastoid tip and in the region between the condyle of the jaw and the auditory canal. No swelling could be made out here. He was suffering considerably from pain and was under weight. The olfactory nerves were negative both subjectively and objectively. The eye grounds were entirely negative for pressure. The extra-ocular movements were good although there was very slight drooping of the lid on the left side. The pupils were equal and reacted actively to light both directly and consensually. There was no diplopia. It was thought that there was very slight atrophy of the temporal and masseter muscles on the left side although patient's jaw deviated to the right on opening. He said that this was due to pain when he opened his mouth. Cotton wool gave a more tickling sensation on the left side of the forehead than on the right. There was apparently slight hypæsthesia to touch in the region of the second and third divisions. Heat was less appreciated on the left than on the right in the entire distribution of the nerve and pinprick was slightly diminished everywhere. The corneal re-

flexes were active and equal. There was no facial paralysis. Hearing was less acute on the left than on the right, watch tick not being heard even at meatus on this side. Tuning fork test showed air conduction better than bone conduction on the right and bone conduction better than air conduction on the left. Weber's test was referred to the left. The remaining cranial nerves were normal. Nothing unusual was made out in the general neurological examination. All superficial and deep reflexes were active and equal and no abnormal reflexes of any sort were obtained. The temperature was normal. The blood pressure was 125—70.

The patient was kept under observation for a period of 2 weeks during which time he continued to have increasing pain in the distribution of the left trigeminal nerve. A slight drooping of the upper lid which was observed on the 18th had increased to complete ptosis by the 30th. During this time the pupils had also become unequal, the left being considerably larger than the right, both, however reacting to light and accommodation. An imbalance of the extra-ocular muscles gradually developed on the left side, and finally there was marked limitation of all the extra-ocular movements except that of the external rectus. The sensory changes in the region of the trigeminal nerve remained about stationary. Caloric tests of the left ear gave normal vestibular responses. The patient was considerably nauseated and was not subjected to the douching of the opposite ear. Spinal fluid examination showed the fluid to be clear, under low tension, and to contain 3 cells per cubic millimeter with negative Butyric and Wassermann reactions. Urinalysis was entirely normal except for a slight trace of albumen. Blood examination gave a hæmoglobin of 78 per cent; color index of .87; white count 9,000; red count 4,452,000; and the differential count showed 79 per cent polymorphonuclears, 20 per cent small mononuclears and lymphocytes and 1 per cent large mononuclears.

A diagnosis was made of tumor in the region of the left gasserian ganglion involving the third, fourth, and eighth cranial nerves.

On February 6, the left ganglion was explored and a rather large amount of bone was removed to allow for subsequent decompression if necessary. The middle meningeal was controlled by packing the foramen spinosum with sterile cotton and then cut across. There was little difficulty in reflecting the dura from the skull. The brain was under no increased tension. As the third division came into view it appeared larger than normal and bluish; in short it resembled a large venous sinus. The body of the ganglion, instead of looking flat and pinkish, presented a swollen purplish appearance. The dura was reflected easily until about three-fourths of the ganglion was uncovered, the sensory root was exposed and the second and third divisions came partially into view. The sheath of the ganglion had apparently disappeared. There was little bleeding. A block of tissue was then removed with a tenotomy knife in the region of the sensory root, about 5 by 5 millimeters in diameter. A second block of tissue was then removed which comprised most of the body of the ganglion. The fossa in which the ganglion lay appeared to be deeper than usual and the tumor was at least 1 centimeter in depth at this point. Small fragments of the tissue were removed from the floor of the fossa with a curette. The wound was closed in layers with fine black silk, no drainage being employed.

I am indebted to Dr. Roy W. Hammack of Los Angeles for the following pathological report.

The specimen is a tumor of the gasserian ganglion. Microscopic examination was made. The tissue is largely fibrous but there are many large and small groups and columns of cells. Several bundles of medullated nerve fibers are seen. The medullated fibers are well preserved and do not show evidence of degeneration.

No ganglion cells are found. The groups of cells are irregular in size and shape. In the largest groups the predominating cells are large, oval with pale nuclei in which the nucleoli are not always visible but sometimes are seen to be multiple. In the smaller groups and strands which are scattered through the fibrous tissue, the cells tend to be smaller and the nuclei stain more deeply: they are also more irregular in size and shape. The cell borders are not distinct. In the smaller groups connective tissue fibers are more abundant than in the larger.

Scattered throughout these groups of tumor cells are a few small round cells of lymphoid type. These are abundant in some places in the fibrous tissue where none of the larger cells is present. No typical mitotic figures are found but there are occasional giant nuclei and many hyperchromatic nuclei. The tumor cells are in some places fairly typical endothelial cells but this is not the case throughout the growth; however, in view of the location it seems that endothelial origin is most likely and the growth may be called endothelioma or fibro-endothelioma.

Within a week after operation the ptosis of the left eye had practically disappeared. The pupils were again equal, the extra-ocular movements had returned to normal except for slight double vision in looking down and to the left. There was incomplete anæsthesia of the region supplied by the second and third divisions together with numbness of the anterior two thirds of the tongue on that side. The region supplied by the first division, however, was little affected. The corneal reflex was still present but very sluggish. The mouth opened straight signifying that the motor root had been preserved. The patient still complained of some dull pain in the forehead and in the lower jaw. On the tenth day slight weakness of the left side of the face was noted for the first time: this increased to a complete peripheral paralysis. He complained of soreness in the region of the left antrum and the left lower jaw and of increased tenderness on pres-

Fig. 1. Low-power photomicrograph of tumor showing infiltration of fibrous tissue by tumor cells. A few bundles of nerve fibers are seen.

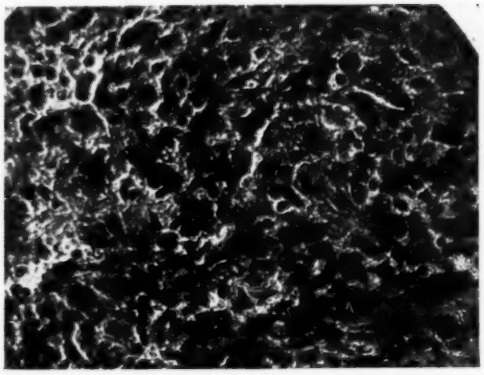

Fig. 2. High-power photomicrograph taken from a cellular area showing irregularity in size and staining of nuclei.

sure over the left styloid process. The wound was perfectly healed by first intention. He was given five deep X-ray treatments by Dr. R. G. Taylor and left the hospital on February 23, 1924. On March 10, the facial paralysis noted above had entirely disappeared. On October 30 he had gained 15 pounds in weight and was having little discomfort in the face or head.

It has been aptly said that "tumor of the gasserian ganglion" is a misnomer. Those tumors occurring in the middle fossa and affecting the ganglion may be divided into two classes: (1) those pressing on the ganglion from without, and (2) those invading this structure itself. Again, tumors of the cerebellopontile angle growing in such a way as to press upon the sensory nucleus of the 5th nerve in the pons may give rise to symptoms which resemble those caused by essential tumors of the ganglion itself. Weisenberg's (66) case of an angle tumor which had been considered one of tic douloureux has often been quoted. Cushing (9) has divided the trigeminal neuralgias caused by tumors into four classes: (1) those arising from the cerebellopontile angle which give symptoms by pressing on the sensory root or on the sensory nucleus in the pons; (2) those neighborhood tumors which cause symptoms by secondary pressure upon the ganglion; (3) those arising from the floor of the skull and invading the middle fossa from below; and (4) those arising from the sheath of the ganglion and invading this structure. Apparently this last type of case which comes nearest to being a true tumor of the gasserian ganglion, is the least frequent of all.

The cerebellopontile angle tumors are now seldom confused with those primarily affecting the ganglion, for the early involvement of the acoustic nerve with localizing cerebellar and general pressure symptoms usually far outweigh those affecting the trigeminal tract. The tumors which grow from the sheath of the ganglion or arise in its immediate neighborhood but do not actually invade this structure probably constitute a majority of this group. Neighborhood symptoms evidenced by involvement of the third, fourth, and sixth nerves are usually pronounced. When inequality of the pupils exists, the smaller pupil has usually been on the side of the lesion, although in the cases of Sachs (55), Parker (47), and the writer the reverse is true. Symptoms of general pressure, headache, nausea, vomiting and even hemiplegia and aphasia may occur. It is surprising how complete may be the destruction of the ganglion and its appendages from pressure directed from above. In Sachs' (55) case the ganglion had been "flattened out to mere paper thinness." On the other hand Cushing has given us examples of ganglia which have been similarly compressed in which there were no symptoms referable to the trigeminal tract. In the class of tumors which arise from the

floor of the skull and erode or encroach upon the ganglion from below, Parker considers that early motor root involvement together with sensory symptoms referable to the second and third divisions of the nerve are to be expected.

The tumors which invade the structure of the ganglion are certainly far less frequent, for the capsule and the structure seem to resist invasion. Like endotheliomata elsewhere, it is probable that these growths arise from the sheath of the ganglion or from the projections of the arachnoid villi invading it. These tumors show a tendency to invade the floor of the skull and may grow into the posterior fossa along the sensory root or even seek exit by the foramina through which pass the various divisions of the nerve.

There are conflicting opinions as to the pathology of these tumors. Of the 43 cases summarized by Frazier (14) up to 1918, 15 were described as sarcomata, 10 as endotheliomata, 3 as carcinomata, 3 as gliomata, 2 as gummata and one each as fibroma, neurocyst, and aneurysm, while 7 were not diagnosed. The 14 cases which I have found reported since include 7 endotheliomata, 1 carcinoma, 1 glioma, 1 fibroma (?), 1 adamantoma, 2 epitheliomata and 1 osteochondroma. Summarizing the total of 57 cases to date we find, then, 15 sarcomata, 17 endotheliomata, 4 carcinomata, 4 gliomata, 2 gummata, 2 fibromata, 1 neurocyst, 1 aneurism, 1 adamantoma, 2 epitheliomata, 1 osteochondroma, and 7 unclassified.

The cellular pathology presented is a confusing one. Probably most of the cases designated as sarcoma should come under the endothelioma heading. Parker (47) questions his diagnosis of fibroma and Shelden (57) states that 2 of his endotheliomata are "indistinguishable from squamous cell epithelioma of a high degree of malignancy." Sachs believes that some of the cases reported as carcinoma belong to the endothelioma grouping. He summarizes the general pathological picture as follows: "The salient features that Marchand (44) emphasized are a reticulum of connective tissue fibrils which seem to be part of the dural covering of the ganglion. Scattered through this are round or polygonal epithelial like cells with clear homogeneous transparent cytoplasm. In places the growth looks like a large round cell sarcoma but in many places like a malignant epithelial tumor. At times there is acinar formation. These facts, together with the peculiar relation to the ganglion cells, led Marchand (44) to think that these cells might be identified with those lining the capsule of the ganglion cells and also the cells of the sheath of Schwann. If this is correct, the tumor would be an endothelioma." Whatever their final classification shall be, it is certain the majority of these cases are clinically malignant. The first case operated upon to be presented in this country (Dercum, Keen, and Spiller, 11) is of unusual interest because of the fact that the tumor not only invaded the ganglion itself but small daughter growths were found scattered on the inner surface of the dura in the immediate vicinity. These gave the appearance of miliary tubercules but on section proved to be endotheliomata similar in structure to the mother growth. I know of no other instance of this finding although cases have been reported where the tumor had broken through the dura and invaded the temporal lobe. Another unusual picture in the pathology is that undoubtedly a certain percentage of the proven endothelioma cases present enlargement of the cervical glands. When these have been sectioned true endotheliomatous tumors have been found. In fact, on several occasions the endothelioma of the cervical gland has been diagnosed before that of the ganglion itself.

While the symptoms are often primarily directed toward the trigeminal structures the first discomfort may not be in the face. In the case presented, the earliest complaint was "pain in the ear" which may be attributed to involvement of those fibers of the nerve supplying the anterior half of the ear drum and the external auditory canal. The pain in the general distribution of the trigeminal field in these cases differs from that of true tic douloureux in that it is more steady and grinding. Constant burning in the distribution of some one of the three divisions has been described as a very early symptom. The pain may be more severe at night. It may

start in the area supplied by the ophthalmic division later spreading to the maxillary or mandibular areas or vice versa. As the ganglion becomes more involved the pain becomes more constant and intense. Relief by various sinus and nasal operations, extraction of teeth, removal of tonsils, etc., is commonly sought without avail. Various forms of paræsthesias appear. The part supplied by one or more divisions may become hyperæsthetic, later going over to hypæsthesia and finally becoming completely anæsthetic. Corneal ulcers may occur. In certain instances, motor root symptoms are seen with relative weakness of the muscles of mastication on the affected side. There may be diminution of taste on the anterior two-thirds of the tongue and even anæsthesia in this area. Pain in the tongue may be present. Enlargement of the cervical glands is common. Among the early neighborhood symptoms are those affecting the third, fourth, and sixth groups of nerves. Increasing palsy of the external rectus or limitation of other associated ocular movements may appear. Drooping of the upper lid and inequality of the pupils are to be expected. When the motor root is affected weakness and atrophy of the temporal and masseter muscles occur. There may be deafness or tinnitus in various forms where the eighth nerve is implicated.

In view of the existing pathology, alcohol injections have given little benefit. Surgical interference has also been, on the whole, disappointing. The majority of cases have proven inoperable so far as the complete removal of the growth is concerned. Frazier (14) emphasizes this and states that "when a radical operation was ambitiously but unwisely attempted, the results were in most cases disastrous." However, one should not hesitate to remove all the growth that is consistent with safety and section the sensory root for palliation. Since there have been recurrences in most of the cases operated upon, it would seem reasonable to follow surgery by a thorough course of deep X-ray treatments.

BIBLIOGRAPHY

1. Bell C. The nervous system of the human body: embracing the papers delivered to the Royal Society on the subject of the nerves. London, 1830.
2. Bezold. Arch. f. Ohrenh., xxi, 4. Quoted from Marchand.
3. Blessig. Klinische Beitraege zur Lehre von der Sehnervenentzuendung. Quoted from Marchand. St. Petersb. med. Ztschr., 1866, x, 65.
4. Cadwalader, W. B. Significance of facial pain in determining the location of intracranial tumor. Arch. Neurol. & Psychiat., 1920, iv, 181–184.
5. Clark and Taylor. Tic douloureux of the sensory filaments of the geniculate ganglion: operation: recovery. J. Nerv. & Ment. Dis., 1910, xxxvii, 242, 511.
6. Idem. True tic douloureux of the sensory filaments of the facial nerve. J. Am. M. Ass., 1909, liii, 2144.
7. Cushing, H. The sensory distribution of the fifth cranial nerve. Johns Hopkins Hosp. Bull., 1904, xv, 213–232.
8. Idem. Perineal zoster; with notes upon cutaneous segmentation postaxial to the lower limb. Am. J. M. Sc., 1904, March.
9. Idem. The major trigeminal neuralgias and their surgical treatment based on experiences with 332 gasserian operations. Am. J. M. Sc., 1920, clx, 156–184.
10. Dana, C. L. Natural history of tic douloureux with remarks on treatment. J. Am. M. Ass., 1900, xxxiv, 1100–1103.
11. Dercum, F. X., Keen, W. M., and Spiller, W. G. Endothelioma of the gasserian ganglion: two successive resections of the ganglion: first by the extradural (Hartley-Krause) operation, and secondly, by an intradural operation. J. Am. M. Ass., 1900, xxxiv, 1026–1033.
12. Dixon. Tumor of gasserian ganglion. J. Med. Chir., London, 1846, xxix, 131–136.
13. Fothergill, J. Of a painful affection of the face. Med. Obs. & Inq., 1773, v, 129.
14. Frazier, C. H. An operable tumor involving the gasserian ganglion. Am. J. M. Sc., 1918, clvi, 483–490.
15. Idem. Tumor of the gasserian ganglion. J. Nerv. & Ment. Dis., xlv, 440–441.
16. Giani, R. Ueber einen Fall von Endotheliom des Ganglion Gasseri, anatomische pathologische und klinische Betrachtung. Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1908, xix, 452; Policlin, 1908, xv, 425; Ann. del. r. Ist. di clin. chir., 189.
17. Goodhart, J. F. Fibrosarcoma of left gasserian ganglion. Tr. Path. Soc., Lond., 1886, xxxvii, 21.
18. Gordon, R. G., and Carleton, H. H. Hysterical pain. Brain, 1923, xlvi, 221–236.
19. Guensburg, Fr. Die pathologische Geweblehre. Leipzig: 1848, ii, 133. Quoted from Marchand.
20. Hagelstam, J. Laehmung des Trigeminus und Entartung seiner Wurzeln infolge einer Neubildung in der Gegend des Ganglion Gasseri. Deutsche Ztschr. f. Nervenh., xiii, 205.
21. Idem. Fur lamning af trigeminus och degeneration af dess rotter pa grund af nygildung ltrakten af ganglion Gasseri inlagg 1 fragan om trigeminus trofiska betydelse. Finska laek. saellsk. handl., 1897, xxxix, 157.
22. Harris, W. Persistent pain in lesions of the peripheral and central nervous system. Brit. M. J., 1921, ii, 896–900.
23. Hartig, K. E. K. Beitrag zur Kenntniss der Neubildungen am Ganglion Gasseri. Berlin, 1911, G. Schade.
24. Hausch, F. Neurogliom des Ganglion Gasseri. Muenchen. med. Wchnschr., 1886, xxxiii, 702.

25. Hellsten, M. Ein Fall von Ganglion Gasseri-Tumor. Deutsche Ztschr. f. Nervenh., 1914, lii, 290–305.
26. Henschen, F. Ueber Geschwuelste der hinteren Schaedelgrube insbesonders des Kleinhirn. Jena, 1910.
27. Heslop. Fibroid tumor of the middle fossa, etc. Med. Times & Gaz. 1868, 442.
28. Hofmeister and Meyer. Operierter Tumor des Ganglion Gasseri. Deutsche Ztschr. f. Nervenh., 1906, xxx, 206–222.
29. Holmes, E. Intranasal treatment of Meckel's ganglion. Ann. Otol., Rhinol. & Laryngol., 1913, June.
30. Homen, E. Festschrift des Pathol. Instituts z. Heidelberg, 1890, s. 35; Neurol. Zentralbl., 1890, 385.
31. Idem. Zur Kenntniss der Hemiatrophia facialis und des Ursprungs des Nervus trigeminus. Neurol. Zentralbl., 1890, ix, 385–430.
32. Hunt, J. R. Herpetic inflammations of the geniculate ganglion. Tr. Am. Neurol. Ass., 1906.
33. Idem. Otalgia considered as an affection of the seventh cranial nerve. Arch. Otol., 1907, xxxvi.
34. Idem. Herpetic inflammations of the geniculate ganglion. Am. J. M. Sc., 1908, August.
35. Idem. The sensory system of the facial nerve and its symptomatology. J. Nerv. & Ment. Dis., 1909, xxxvi, 331–350.
36. Idem. The sensory field of the facial nerve: a further contribution to the symptomatology of the geniculate ganglion. Brain, 1915, xxxviii, 418.
37. Klebs, E. Beitraege zur Geschwulstlehre. Prag. Ztschr., cxxxiii, s. l. Quoted by Marchand.
38. Krause, F. Operationen in der hinteren Schaedelgrube. Arch. f. klin. Chir., 1906, lxxxi, 40–60.
39. Krepuska. Tumor of gasserian. Monatschr. f. Ohrenh. Berlin, 1898, xxxii, 78.
40. Krogius. Rev. de Chir., 1896, xvi. 434.
41. Krogius, A. Om operativ behandlund af tumoren i fossa media cranii. Finska laek. saellsk. handl., 1895, xxxvii, 386.
42. Lexer, E. Zur Operation des Ganglion Gasseri nach Erfahrungen an 15 Faellen. Arch. f. klin. Chir., 1902, lxv, 843–928.
43. Little. Tumor of gasserian. Dublin J. M. Sc., 1873, 54.
44. Marchand. Beitrag zur Kenntniss der Geschwuelste des Ganglion Gasseri. Festschrift f. George Edouard Rindfleisch, Leipzig, 1907.
45. Oppenheim, H. Text-book of nervous diseases. Edinburgh: Schulze, 1911.
46. Orsi. Gazz. med. ital. lomb., 1869, p. 265.
47. Parker, H. L. The clinical significance of pain in the area supplied by the fifth cranial nerve. Minnesota Med., 1923, vii, No. 2, 69–79.
48. Patrick, H. T. The symptomatology of trifacial neuralgia. J. Am. M. Ass., 1914, lxii, 1519–1525.
49. Petrina. Klinisch. Beitrag z. Lokalisation der Gehirntumoren. Prager Vierteljahrschrift, f. d. praktisch, Heilk. Jahrg. 34, 1877, cxxxiii, 95; cxxxiv, 1. Quoted by Marchand.
50. Plummer, W. A., and New, G. B. Tumor of the middle cranial fossa, involving the gasserian ganglion. J. Am. M. Ass., 1914, lxii, 1082–1083.
51. Pollock, H. Difficulties and complications of sphenopalatine ganglion injections. Ann. Otol., Rhinol. & Laryngol., 1906, xxv, 958–966.
52. Putnam, J. J. On periodical neuralgias of the trigeminal nerve and their relation to migraine, with special relation to the intermittent supra-orbital neuralgia. Boston M. & S. J., 1896, cxxxv, 53–55; 81–84.
53. Rosenthal. Fall von metastatischen Tumoren an der Basis cranii. Ztschr. f. klin. Med., 1880, ii.
54. Sachs, B., and Berg, A. A. Operative Heilung einer Geschwulst des Ganglion Gasseri. Berl. Klin. Wchnschr., 1913, i, 1395.
55. Sachs, E. Tumors of the gasserian ganglion, with report of an operated case. Ann. Surg., 1917, lxvi, 152–159.
56. Schmidt, M. B. Ueber die Pacchionischen Granulationen und ihr Verhaeltniss zu den Sarkomen & Psammomen der Dura Mater. Arch. f. path. Anat., 1902, clxx, 429.
57. Shelden, W. D. Tumors involving the gasserian ganglion. J. Am. M. Ass., 1921, lxxvii, 700–705.
58. Sluder, G. Headaches and Eye Disorders of Nasal Origin. St. Louis: C. V. Mosby Company, 1918.
59. Soderbergh. Ein Fall von Trigeminustumor mit Symptomen von Kleinhirn-brueckenwinkel. Nord. med. Ark., 1909, Abt. xi., Hft. 34.
60. Soulier. Tumeur sarcomateuse du cervelet. Lyon Med., 1872, 251.
61. Spiller, W. G. Tumor of the gasserian ganglion. Am. J. M. Sc., 1908, cxxxvi, 712–725. Remarks on the central representation of sensation. J. Nerv. & Ment. Dis., 1915, xlii, 399–418.
62. Sternberg. Mehrfache halbszeitige Hirnnervenlaehmung durch Krebs der Schaedelbasis. Ztschr. f. klin. Med., xix, 579.
63. Trenel. Tumor of gasserian. Bull. Soc. anat. de Par., 1899, 326.
64. Verger, v. Grenier de Cardenac. Neuralgie Faciale et Tumeur du Ganglion de Gasser. Rev. neurol., 1905, No. 14, p. 704.
65. Weeks, S. H. Surgery of the gasserian ganglion. Tr. Am. Surg. Ass., Phila., 1908, xxxvi, 34.
66. Weisenberg, T. Cerebellopontile tumor diagnosed for six years as tic douloureux. J. Am. M. Ass., 1910, liv, 1600–1604.
67. Woltman, H. Malignant tumors of the nasopharynx with involvement of the nervous system. Arch. Neurol. & Psychiat., 1922, viii, 412–428.
68. Willius, F. A. A typical pain with angina pectoris. Med. Clin. N. Am., 1921, v, 455–467.

EXTENSIVE RESECTION OF THE SMALL INTESTINE IN AN INFANT

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EXTENSIVE resection of the small intestine is a subject of keen interest alike to the surgeon and the physiologist. Just how great a length of small intestine may be removed without jeopardizing the future health and growth of the individual is a moot question. The consensus of opinion would indicate that in man, approximately six feet (1.83 meters) may be removed without any great risk of subsequent serious damage to the assimilative powers. As a matter of fact, however, the resection of less than this amount of ileum has resulted in profound digestive disturbances. Undoubtedly, the various discrepancies between the lengths of intestine resected and the subsequent presence or absence of serious metabolic disturbances noted in the recorded cases may be explained when one takes into consideration the age and general condition of health of the patient, the pathological lesion for which the resection is performed, and the uncertainty concerning the relative length of the piece resected in a particular individual. On the other hand cases are on record in which almost twice the arbitrary amount of small intestine has been resected without any marked metabolic disturbances. Thus, to the surgeon this problem is largely one of purely academic interest. The experimental work of Senn, Trzebecki, Monari, and others indicates that a relatively greater amount of small intestine may be removed from animals than from man with physiological safety. Senn's pioneer work on cats and dogs led him to the conclusion that the excision of more than one-third of the whole of the small intestine is an operation dangerous to life, productive of marasmus, and in this way eventually fatal.

In experimental work it is possible to measure the length of the remaining bowel as well as that removed, and thus to determine the relative value of the portion excised as compared with the whole. In clinical cases, however, the exigencies of the situation are generally such that it is not feasible for the surgeon to ascertain at all accurately important factors, such as the particular portion of the small intestine which is being removed, and the correct measurement of the length of intestine which remains after resection. The excision of a large portion of the jejunum may have much more serious consequences physiologically than that of an equal or greater length of ileum. The length of intestine remaining is, according to Dreesman, a factor of far greater moment in the ultimate result than the amount excised.

While Senn's conclusions have been practically corroborated by the subsequent work of others, the surgeon cannot be guided solely by experimental work, as he is compelled, as a rule, to resect to the limit set by the pathological condition which necessitates the operation. The conservation of every possible bit of small intestine is of paramount importance, especially in extensive resections. If the patient dies directly after operation, the case is not reported no matter how great an amount of bowel has been resected; such cases are not of interest to the physiologist, as the evidences of metabolic disturbance have not had time to become apparent. I recall a resection of small intestine in a middle aged woman for gangrene due to thrombosis of the mesenteric vessels in which the excised portion measured 14 feet (4.26 meters). The patient died 24 hours after the operation. The mortality rate of the recorded cases is, therefore, low, being only 16 per cent according to Flint. This of course is no criterion of the severity of the operative procedure in itself.

It is also apparent that many factors, aside from the length of bowel excised, may have an important bearing in individual patients. Cases cannot be compared merely on the ground of the actual lengths of intestine removed. We may subtract the amount removed from the average length of the small intestine which Treves, as a result of the examination of 100 bodies, places at 22 feet, 5 inches (6.83 meters); but the variability of

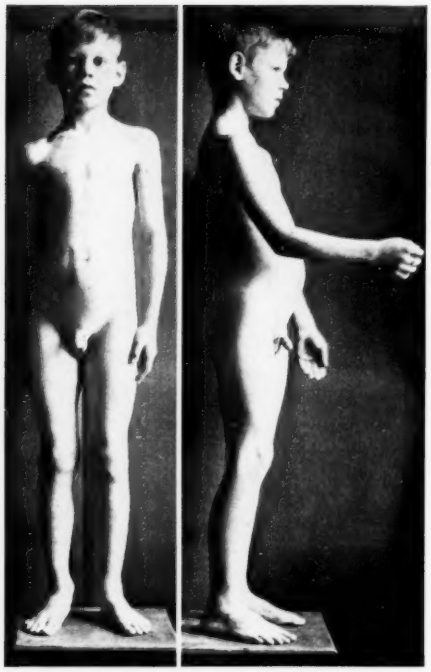

Fig. 1. Nine-year-old boy 7 years after resection of 4 feet 8 inches of ileum for acute intestinal obstruction due to strangulated internal hernia through congenital foramen in mesentery.

Fig. 2. Side view of patient shown in Figure 1.

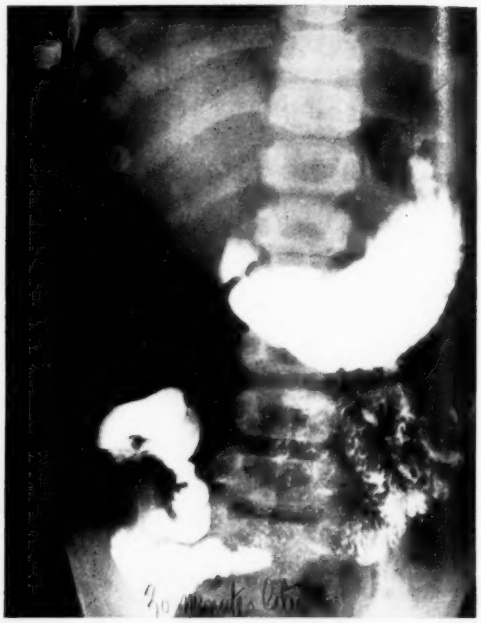

Fig. 3. Roentgenogram of gastro-intestinal tract showing that only about 12 inches of ileum remain. The mid-portion of the colon hangs at about the brim of the pelvis, owing to the fact that part of the supporting viscera has been removed.

the actual length of the small intestine is very great. In Treves' series there was a difference of more than 16 feet (4.87 meters) between the extreme cases in one of which the intestine measured 31 feet (9.44 meters) and in the other only 15 feet 6 inches (4.72 meters). Great variability has also been noted by other investigators.

In infants and children the difficulty is further increased by the apparent lack of a law of proportion concerning the relative length of the intestine in the child and adult. There is no ascertainable proportion between growth in length of intestine and the age of the patient, growth during childhood being very rapid in some and comparatively slow in others. Growth of the small intestine as a rule, however, continues until adult life. Robbin, in a series of autopsies on 185 children at the Babies Hospital, New York, found that the small intestine varied between 500 and 900 per cent of the body length.

Blayney, in 1901, was able to collect 33 cases, including his own, in which more than 3 feet 4 inches (1 meter) of small intestine had been removed. Death was practically coincident with the operation in 9 cases, due to shock, or pre-existing peritonitis. Of the patients who recovered and lived any length of time, some showed symptoms of intestinal disturbances chiefly in the form of a tendency to diarrhœa; but others in whom an equally great extent of small intestine had been removed were apparently not at all affected. This was especially noteworthy in Ruggi's case, a boy, aged 8, from whom 11 feet (3.35 meters) of small intestine was removed with recovery and good health one year after operation.

In analyzing the cases of 7 adults who showed subsequent disturbances, Blayney found that the length of intestine removed was

practically 2 meters; this he considered as the approximate limit compatible with health.

Children, if estimations are to be based on Ruggi's case, apparently do not come within the same limitations as the adults. It may be that a more pronounced compensatory hypertrophy of the remaining intestine occurs in children than in adults. Senn, Monari, Flint, and others found that in animals which showed no intestinal trouble after operation a marked hypertrophy of the intestine occurred.

One would naturally assume that the younger the child the more it would be physiologically handicapped by the abstraction of a given amount of small intestine inasmuch as the need for an adequate absorption surface is so important not only for the purposes of functional metabolism but also for the added requirements of growth. The intestine probably rarely functions to the limit of its capacity; like many other organs, it has a reserve power which may only occasionally be called into use. Is this reserve power of an organ coincident with birth or does it gradually increase from birth to maturity? When the amount of small intestine removed exceeds the amount necessary to maintain the theoretical factor of safety reserve in the absorption power of the intestine, roughly estimated by Bardeen at 25 per cent of the small intestine, there should almost automatically follow evidences of disturbed metabolism and, in a child or infant, impairment of growth. The severity of these manifestations would be directly proportional to the amount of intestine removed in excess of that necessary to maintain the factor of safety. The gradual amelioration and eventual disappearance of symptoms of disturbed metabolism and impaired growth over a period of years with an eventual return to a hazardous normal, in that indiscretions in diet and minor intestinal ailments result in marked diarrhœa with rapid loss of weight, may be offered as clinical evidence that, in the particular individual concerned, the amount of intestine removed, whatever its actual length in centimeters, was the approximate extreme limit compatible with health. The experimental work of Flint and others on dogs shows that when such an extent of intestine is removed as to deprive the animals of the factor of a reserve safety absorption area, or capacity, the diminished absorption involves the adaptive powers of the remainder of the intestine, and a compensation for the loss is established in hypertrophy of the remainder. This hypertrophy, while involving all the layers, is more patent in the tunica mucosa than in either the submucosa or muscularis and involves the crypts as well as the villi, resulting solely in an increase in size and not number. The compensatory process results in hypertrophy as well as hyperplasia of the remaining portion of the small intestine.

The increased bulk in the intestinal tissues is apparent in an increase in the transverse dimension only, there being no measurable increase in length in Flint's animals. How marked an increase in absorption area may be produced by compensatory hypertrophy may be appreciated by recalling that in more or less cylindrical structures, as the villi and crypts, an increase of 100 per cent in size would lead to an increase of 400 per cent in surface area. Such an increase was noted in some of Flint's animals. A proper appreciation on the part of the surgeon of the potential effects of compensatory hypertrophy of the small intestine after extensive resection, especially in infants and children, should encourage him to make every effort to conserve the life of his patient during the stormy and trying periods of convalescence no matter how extensive the resection and in spite of the apparent hopelessness of the situation. As Flint remarks, "The history of the operations on the human intestine parallels in all respects the experiments upon our animals." Schlatter's case particularly, with the diminished absorption which persisted for almost two years, reached finally such a stage of compensation that his patient, an Italian, could eat the frugal diet of his people. In this case there is little question that the hypertrophic process was slowly taking place.

The length of time necessary for such compensatory hypertrophy to take place naturally varies with the patient, his age, the amount of intestine removed, the diet, and so forth. In my case, an infant aged 2 years, approximately 7 years passed before the adaptive

power of the intestine was fully established. Flint's computations show that the compensatory enlargement of the crypts and villi approximately restores the surface of the intestine. Presumably this would be indicated by the establishment of a state of normal metabolic equilibrium, as evidenced by normal absorption and growth. An individual in whom this had occurred, however, would in all probability lack the reserve absorption power of the normal person and would constantly be using the full absorption power of his intestine. Any impairment of this power, or added demand placed on it, would bring out its inherent weakness.

Cases of extensive resection of the small intestine in infants are extremely rare in the literature. The youngest patient I have been able to find in whom as much as 1 meter of small intestine was removed successfully is that reported by Flint. In 1910, 1 meter of ileum was removed in an 11 month's old infant for intussusception with gangrene. Flint includes this case in his series because the small intestine in infants of this age is only 9 feet (2.7 meters) long and, therefore, the resection of 3 feet 3½ inches (99 centimeters) is equivalent to the arbitrary limit of 6 feet 7 inches (2 meters) in adults.

Flint in a personal communication in answer to my query about the approximate length of the small intestine in a male infant 2 years of age, very aptly states, "I have no data on the length of the infantile intestine at the age you mention. The problem is a good deal like that which interests the mathematicians and which they call the function of a complex variable. Measurements with and without the mesentery, with and without various degrees of distention and stretching, are so different that it is impossible to establish a norm. The only thing to do, I think, is to establish comparative measurements under similar conditions. What I did was to distend the excised intestine with formalin under a given head of pressure of water and then secure a normal intestine of the same age, distend with the same pressure and compare the measurements."

Watson in a most comprehensive review of the literature to date states that the total number of recorded cases of extensive resection of the small intestine, including his own case, is still comparatively small, being 73. Presumably this list includes the collection of Blayney, published in 1901, which numbered 33 and listed all cases in which more than 1 meter of small intestine had been removed. Flint includes in his list the case of the infant, aged 11 months, in whom he resected 3 feet 3½ inches (99 centimeters), because "this measurement is equivalent to the arbitrary limit of 6 feet, 7 inches (2 meters) in adults." If this arbitrary limit is the criterion of whether a given case should be listed as "extensive resection," I should hesitate to classify my case in such a way from the mathematical standpoint, as neither the average length of the male intestine at exactly 2 years of age nor the proportionate value to be given to a resection of 4 feet 8 inches (1.42 meters) of small intestine in such a subject has been determined.

There can be no question, however, that in any case in which the resection of a relatively large amount of small intestine is followed by prolonged metabolic disturbances, as evidenced by continued diarrhœa and nutritional impairment, the clinical evidence is sufficient to warrant the assumption that in the particular individual concerned the amount of small intestine removed, whatever its exact length, was extensive enough to jeopardize the health of the individual.

The case herewith presented falls clinically in the class of extensive resection of the small intestine and is deemed worthy of record as it presents the interesting features of:

1. Extreme youth of the patient.
2. The opportunity of occasional observation over a period of seven years.
3. An analysis of the end-results at the present time.

REPORT OF CASE

R. B., a male infant, aged 2 years, was admitted to the hospital March 13, 1916. Three days previously the child woke up crying and seemed to the mother to be suffering with intense abdominal pain. A single, unusually large bowel movement occurred which was the last before admission to the hospital. This was followed by repeated vomiting. The vomitus became foul and black the day before admission.

The child appeared to be in an extremely critical condition with marked evidence of dehydration, and frequent vomiting of foul, almost black, material. Multiple, doughy-like areas of distention were palpated in a slightly rigid abdomen, but no definite masses could be felt. Rectal examination proved negative, except for a ballooned condition. The pulse was 160, temperature 103.2 degrees, and respirations 48. The leucocyte count was 9,500.

A diagnosis was made of complete intestinal obstruction of unknown origin, with a practically hopeless prognosis. We suggested to the parents that after hypodermoclysis, we might open the abdomen under local anæsthesia and perform an enterostomy as a palliative measure.

Operation. When the abdomen was opened through a mid right rectus incision, there was presented a huge mass of green, completely gangrenous coils of small intestine. As far as could be judged from inspection and palpation the gangrenous condition involved all of the small intestine. The father of the child, who was in the operating room, was informed that the condition was absolutely hopeless and left the room. Our scientific curiosity concerning the etiological factor involved in the case was fortunately piqued to such an extent that I was incited to remark, "This child is practically dead; an autopsy may be refused. I am enlarging the abdominal incision sufficiently to permit a definite decision as to the cause of the obstruction." When the snaky, ball-like mass of gangrenous intestine was delivered a ring-like, constricting structure was felt surrounding its pedicle. On division with the scissors, the whole snarled mass of intestine was unraveled and the condition revealed as strangulated internal hernia through a congenital foramen in the root of the mesentery. It was also apparent that there was an appreciable length of small intestine in a viable condition, an amount which in its collapsed condition seemed scarcely to equal that of the gangrenous portion. A rapid resection of the gangrenous intestine and involved mesentery, which was also in a gangrenous condition, was performed. The bowel ends were closed and a lateral anastomosis established, with closure of the mesentery gap. The abdominal wall was closed with through-and-through silkworm sutures, and 500 cubic centimeters of hot saline solution poured into the peritoneum before closure was completed. Hypodermoclysis was continued during the operation. Aside from the primary infiltration of the abdominal wall with novacaine, no anæsthetic was used, the child being in such a moribund condition that it paid no attention to the intra-abdominal procedures.

The lower end of the resected intestine was about 2 feet (60 centimeters) from the ileocæcal junction, and the piece of resected ileum, after it had been in a 10 per cent formalin solution one week, measured 4 feet 8 inches (1.42 meters). This measurement was made without any attempt to uncoil or stretch the bowel, or detach it from the mesentery, a wedge shaped piece of which had been excised with it.

Postoperative course. At the time the patient was removed from the operating room the pulse was 176, and barely perceptible, the rectal temperature 102 degrees, and respirations 52. During the first 48 hours following operation the child remained in an extremely critical condition, vomited copiously 3 times, but the vomitus was of a greenish hue and no longer foul. During this time practically continuous proctoclysis and hypodermoclysis were maintained. A thorough colonic flushing was followed by the escape of considerable gas and a brownish liquid stool. The following day 5 bowel movements were noted on the record. During the remainder of the 30 days' stay in the hospital the bowel movements averaged 11 a day. During the day and from day to day as noted in the records they varied in:

1. Consistency—from usually purely liquid to soft and putty-like,
2. Color—light yellow, green, brown, clay,
3. Odor frequently noted as foul; then again as practically without odor. Occasionally mucus and undigested particles of food were noted in the stools. The diet in the hospital consisted of plain, malted peptonized milk and brandy, jellies, and later eggs, creamed toast, broths and so forth.

Medication consisted in paregoric 20 minims doses every 4 hours. The gravity of the convalescence was increased by a wound infection, which developed at the end of the first week, a severe attack of bronchopneumonia, which appeared in the second week, and a double otitis media purulenta, which matured in the third week.

Subsequent history. I have recently had an opportunity of examining this boy and questioning his mother on his progress since leaving the hospital.

Previous to 2 years ago the patient was greatly bothered by looseness of the bowels, often having 7 or 8 unformed movements a day, or more. During the first year after leaving the hospital the mother despaired of his surviving, as the bowel movements were almost continuous. Each year since she has noted some improvement until this year when conditions are practically normal, the boy having only one formed movement each day.

The child has always been much thinner than other boys of his age until last year when a decided improvement in this respect was noted. He has always been very active in play and generally displays ravenous appetite. He cannot bear to go without food even the usual length of time, and therefore lunches between meals and insists on having plenty of candy and sweets each day.

About three times a year the boy has had spells of "stomach trouble" which last from a few days to two weeks, during which he complains of severe diarrhœa accompanied by generalized abdominal distress and occasional vomiting. During a severe spell last year he lost 20 pounds in weight in 10 days. He has always made a quick recovery from these attacks with a rapid regain in weight. During the past year he has been perfectly free from these attacks.

I am indebted to Prof. C. R. Bardeen of the Anatomical Department of the University of Wisconsin for the following remarks submitted after a recent examination of the boy.

R. B., aged 9 years, 7 months, height 58.5 inches, sitting height 28.1 inches, relative sitting height 54.78 per cent, weight 58.5 pounds. This boy is well built and of about average stature for his age and of about average weight for his stature. He has a relatively long trunk for his stature. The sitting height at his age is usually about 53 per cent of the stature, instead of nearly 55 per cent. There are, however, considerable individual variations in this respect in children so that this feature is probably insignificant. Children with long trunks are apt to be relatively more stocky than others of the same stature, but this is not the case in this instance.

Robert was two years old at the time of operation. We have no data on his stature and sitting height at that time. We may reasonably assume an average stature at that age of 33.5 inches and a sitting height of 20.2 inches. According to Von Pirquet, the length of the intestines averages about ten times the sitting height. This would make the total length of the intestines in this child 202 inches. The length of intestine removed was 54 inches, or about one-fourth of the total length.

Von Pirquet believes that the basis of studies on nutrition should be food absorption rather than heat elimination from the body at rest. The absorption area of intestine thus becomes of greater importance than surface area of body. We have even less accurate knowledge concerning the former than the latter. Von Pirquet, on the basis of available data, assumes an average absorption area of the intestines equal to the square of the sitting height. In this case this would be 408 square inches. On the assumption that the average surface width of the part of the intestines removed was equivalent to the average width of the intestines as a whole, the absorption area in this case was reduced by the operation from about 400 to about 300 square inches. Von Pirquet found that in young children on a milk diet it was necessary to have an absorption of 0.3 gram per estimated square centimeter of surface area of intestine each 24 hours in order to maintain equilibrium of weight, and of 0.59 gram or more for growth. Over one gram per square centimeter may be absorbed. There is, thus, a theoretical factor of safety present in absorption power of the intestines more than sufficient to cover the loss of one-fourth of the intestines. To what extent readjustment may have taken place in the present instance through compensatory hypertrophy we cannot say.

The following is the report of Dr. Newton Sisk of the Section of Roentgenology of the Clinic:

The size, shape and position of the stomach, its movability and peristalsis, are normal. Thirty minutes *post cibum* the head of the meal is entering the caput coli, and at two hours *post cibum* the head of the meal is in the rectum, with the colon fairly well filled, except the cæcum which seems to have a gas bubble in it. The observations were concluded at this time. The stomach appears to have approximately a normal residue two hours *post cibum*. The mid-portion of the colon hangs at about the brim of the true pelvis, which is to be expected from the fact that part of the supporting viscera, a portion of the small intestines, has been removed.

The length and position of the duodenum appear to be normal, and the meal traverses it in an uneventful physiological manner. The lumen of the duodenum is not recorded on the plate, but the passage of the meal is observed under the fluoroscope. From our observations and from the record on the plate we conclude that approximately a normal amount of jejunum remains and the position and behavior of the viscus are normal. There is a distinctly recognized absence of the proximal ileum, there remaining only about 12 inches of the distal part of this member which is apparently well filled, and freely movable; in no particular is there any unusual behavior of the organ.

A report from the clinical laboratory shows the following: Urine: specific gravity 1.028, reaction acid, albumin and sugar negative; blood: hæmoglobin 70 per cent, erythrocytes, 4.8 per cent, neutrophils 46.5 per cent, eosinophils 5 per cent, and basophils 0.5 per cent. The basal metabolic rate was + 4 per cent.

Examination of the stools showed a practically normal condition with regard to nitrogen fat and carbohydrate elimination. At the time operation was performed the hospital in which the patient was placed had no facilities for proper scientific laboratory analysis of the stools.

CONCLUSIONS

While experimental work on animals and the record of numerous surgical operations on adults offer sufficient material for the formulation of rather broad conclusions in regard to the amount of small intestine which may be excised without jeopardizing the life of the individual, the paucity of cases of extensive resection of the small intestine in children, and especially infants, is such that there may be some question of whether the same general conclusions may be applied to them as to adults. Conceivably the infant, if it survives the immediate effects of the operation, may exhibit a greater adaptive power in the remaining small intestines than the adult.

NOTE.—A short time after I submitted my article to the editors of SURGERY, GYNECOLOGY AND OBSTETRICS, Bryant published a most comprehensive and instructive article on the growth and length of the human intestine. He says:

"Recent literature upon the growth and length of the human intestine is conspicuous by its absence. The older literature is often contradictory, possibly because it was based on inadequate sources."

He presents in this extensive work what is believed to be a larger and more accurate series of data than any previously presented, based on original observations of 242 individuals of all ages and both sexes with regard to intestinal growth and length. In the data relating to males at 2 years of age the length of the small intestine is given as 4 to 4.25 meters. Based on this data the length of small intestine removed in my case was practically two-fifths, or a little more than one-third, of the whole.

REFERENCES

1. BARDEEN, C. R. Personal communication.
2. BLAYNEY, A. On the removal of great lengths of the intestine. Brit. M. J., 1901, ii, 1456–1458.
3. BRYANT, J. Observations upon the growth and length of the human intestine. Am. J. M. Sc., 1924, clxvii, 499–520.
4. CANNADY, J. E. Long resections of the intestine. Ann. Surg., 1919, lxix, 425–431.
5. DREESMAN. Ueber groessere Darmresectionen. Berl. klin. Wchnschr., 1899, xxxvi, 337–339.
6. FLINT, J. M. The effect of extensive resection of the small intestine. Johns Hopkins Hosp. Bull., 1912, xxiii, 127–144.
7. MONARI. Quoted by Watson.
8. ROBBIN, L. Length of large and small intestine in young children. Am. J. Dis. Child., 1920, xix, 370–374.
9. RUGGI. Quoted by Cannady, loc. cit.
10. SCHLATTER. Quoted by Watson.
11. SENN, N. Experimental Surgery. Chicago: Keener, 1889, pp. 522.
12. TREVES, F. The anatomy of the intestinal canal and peritoneum in man. Brit. M. J., 1885, i, 415–419.
13. TRZEBECKI. Quoted by Watson.
14. WATSON, P. A case of extensive resection of small intestine with a clinical study of recorded cases. Edinburgh M. J., 1923, xxx, 164–183.

PAIN AND MUSCLE TENSION CAUSED BY INFLAMMATION OF THE DIAPHRAGMATIC COSTAL AND LOWER PARIETAL PLEURA SIMULATING THAT FROM ABDOMINAL VISCERA[1]

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INNERVATION OF DIAPHRAGM AND CERTAIN ABDOMINAL VISCERA

JUST as anatomy and histology are fundamental to gross and microscopic pathology, so is a knowledge of normal physiology the basis of abnormal or pathological physiology. A knowledge of vegetative neurology and the laws governing reflexes is fundamental to the interpretation of pain, increased muscle tension, and degenerative processes which result from visceral inflammation.

In this paper it is my purpose to discuss the innervation and reflex relationships of the diaphragmatic and lower parietal segments of the pleura and compare them with those of certain important abdominal viscera so as to make clear the manner in which symptoms on the part of the one may simulate those of the other and cause errors of diagnosis to be made.

The diaphragm is an organ made up of two parts: the crura and central tendon innervated almost wholly by the phrenics, and the costal portion innervated almost wholly by the intercostals. Above it is covered by pleura and below by peritoneum which share the same innervation. The lower segments of the pleura which consist of the costal portion of the diaphragmatic pleura, and the lower parietal pleura, receive innervation not only from the lower six intercostal nerves but also from sympathetic nerves, the connector fibers of which arise from the six lower thoracic segments of the cord. These same segments also send sympathetic fibers to all of the important abdominal viscera, and, together with the upper two or three lumbar segments supply sympathetic fibers to all abdominal and pelvic organs as shown in Figure 1. These same segments supply the peritoneum.

The stomach, liver, gall bladder, pancreas, small intestine, upper colon and kidney are almost wholly innervated by sympathetic nerves, the connector fibers for which arise in the lower six thoracic segments. The aorta and spleen receive innervation from the upper six thoracic segments as well. The lower colon and pelvic viscera receive part of their innervation from the lower thoracic quadrants but part also from the upper lumbar (6).

It is thus evident that there is an intimate association in the lower six thoracic segments of the cord between neurons coming from the lower segments of the diaphragm and those from all abdominal and pelvic organs and the peritoneum which affords an opportunity, according to Sherrington's law which will be stated later, of mediating reflexes with the motor and sensory spinal nerves arising from these same lower six thoracic spinal segments. Were it not for the fact that each organ has areas of election, as we might loosely term them, for its reflexes there would be no end of confusion. In spite of the fact that the nerve impulses return from many viscera to the same segments of the cord, the impulses from each organ are most easily transmitted to motor nerves which produce muscle tension in certain definite muscles or certain parts of muscles and to sensory nerves which affect skin areas which are more or less limited and definite, and when other areas are involved the spread follows laws which are well established although not generally known.

In order to understand the rôle played by the nerves which arise from the lower six thoracic segments of the cord in the production of reflex symptoms when the organs which they supply are the seat of inflammatory disease, it is necessary to understand something of the developmental relationships of the various organs and to know the laws which govern the mediation of visceral afferent impulses and their expression in action in skeletal structures.

Innervation of the body follows an orderly arrangement, the exactness of which is quite

[1]Read before the seventieth semi-annual meeting of the Southern California Medical Association, Santa Barbara, California, April 4 and 5, 1924.

remarkable. This can best be understood by considering the body as a segmental organism. This segmental nature of the human body is evident from a comparison of the primitive vertebrate—Amphioxis—and the human embryo in the early weeks of development as shown in Figures 2 and 3. In the primitive vertebrate here represented each segment is more or less independent of other segments. In man the segmental arrangement has also been preserved but individual segments are not so independent as they are in the more primitive state. Different parts are linked together more intimately as the body becomes more complicated and the nervous system becomes more complex. In the simple segmentally arranged organisms the skeletal and visceral structures belonging to each segment are innervated by that portion of the cord lying within the segment. It will be seen that the heart (Fig. 2) is located in the second, third and fourth segments; and so, it is innervated by those same segments of the cord. We know from clinical experience that when diseased the human heart expresses reflexes through somatic motor and sensory nerves arising in these segments, and that there are definite segmental arrangements between the skeletal structures and each organ. When reflexes are expressed in segments other than those usually involved even the variations follow certain physiological laws. These will be given later in this discussion. The early relationships of an organ in its developmental stages determines its innervation and, regardless of where the organ is finally situated in the body, determines the parts of the skeletal structure in which reflex symptoms (muscle tension, pain and degenerative processes) will be expressed when it is inflamed.

LAWS GOVERNING REFLEXES

Reflexes follow certain physiological principles which, on account of the regularity of their operation are spoken of as the "laws of the reflexes." An understanding of these is necessary to the interpretation of many symptoms met in clinical practice. The following are some of the more common laws.

1. Afferent nerves from the viscera carry normal stimuli centralward during health which result in physiological action; and abnormal stimuli when the organs are diseased which result in symptoms. There is an inhibition exerted normally by higher centers which prevents impulses returning from the viscera from producing undue reflex action, and keeps reaction within physiological limits. When the impulse is stronger, however, and adequate to break down whatever resistance is offered, then such abnormal or exaggerated reaction occurs as is recognized as symptoms of disease. So that what is known as an *adequate stimulus* (6) is essential to the production of a reflex symptom.

2. Sherrington (8) suggested it as a law of reflexes that each afferent nerve finds in the same segment of the cord which it enters an efferent nerve which mediates with it as readily or more readily than nerves arising in any other segment. This holds for all of the important viscera except the lung. The fact that the lung differs calls for a modification of the law. So I have suggested that the law be modified to meet the conditions of all viscera, as follows: Every afferent nerve finds in the segment of the cord with which the viscus which it supplies is connected developmentally an efferent neuron which mediates with it as readily or more readily than efferent neurons in other segments. This means the connection is in the same segment as suggested by Sherrington for all important viscera except the lung. The exception on the part of the lung is based on the embryological fact that it develops as the most anterior of all important viscera and arises in the pharynx from a diverticulum given off from the anterior portion of the œsophagus.

3. When a nerve fibril is stimulated to action no amount of increased stimulus can cause it to produce greater action (Lucas, 3; Ver Worn, 9). Increase in the stimulus, however, is manifested by a spread of the impulse to neighboring neurons and results in a wider spread of the action. This fact must be taken into consideration in estimating the origin of visceromotor and viscerosensory reflexes. An overlapping of reflexes is often met in clinical practice which would be inexplicable if it were not for an understanding of this law.

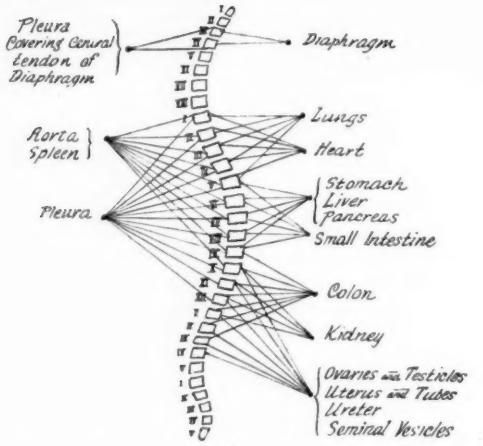

Fig. 1. The connector neurons for the important thoracic, abdominal, and pelvic viscera. In the figure the connecting neurons are those which belong to the thoracicolumbar outflow; except those going to the diaphragm, which are spinal nerves (phrenics). The motor cells for the viscera are found in the various collateral ganglia.

The figure shows that the innervation of the various viscera may be divided into groups. The heart and lungs are innervated from practically the same segments, the upper first to sixth thoracic; the stomach, liver, and pancreas from the same segments, fifth to ninth thoracic; the colon, kidney, and pelvic viscera from practically the same segments, ninth and twelfth thoracic to third and fourth lumbar.

In spite of this grouping in innervation, each organ is brought in reflex connection with efferent neurons, both sensory and motor, which are more or less definite, in such a way that the motor and sensory reflexes do not overlap as much as might be indicated.

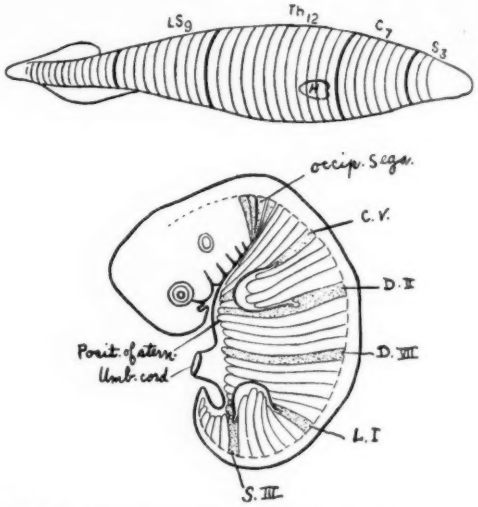

Fig. 2 (above). Diagrammatic representation of a primitive vertebrate animal—the Amphioxus—divided for convenience into three segments for the head, seven for the neck, twelve for the thorax, nine for the lumbosacral region, and an indefinite number for the coccygeal region. For clearness of comparison the heart, *H*, is represented as occupying the same position as in man, so that an adequate stimulus from the heart would cause pain in the distribution of the four upper thoracic nerves covering and protecting the heart. (After Ross and Mackenzie.)

Fig. 3. Diagram of a human embryo, fifth week, showing the arrangement and extension of the mesoblastic segments. The first and last of each segment entering into the formation of the limbs is stippled (*C. V* and *D. II* and *L. I* and *S. III*). The position is indicated in which the sternum is formed. (A. M. Patterson.)

4. While referred sensory disturbance is not a true reflex in the physiological sense of the term, clinically it may be so treated. Consequently, it is necessary to note that pain arising in viscera is not expressed in the organs themselves, but in the more highly sensitive somatic neurons which supply the superficial structures, skin, subcutaneous tissue, and muscles. The nerves which transmit pain to the surface of the body in diseased states are those whose cell bodies lie adjacent in the cord to the cell bodies of the neurons which bring the impulse from the viscus affected. This law has been expressed by Head (1) as follows:

"When a painful stimulus is applied to a part of low sensibility in close central connection with a part of much greater sensibility, the pain produced is felt in the part of higher sensibility rather than in the part of lower sensibility to which the stimulus was actually applied."

DISCUSSION OF LAWS OF REFLEXES

If one will understand the reflex motor, sensory and trophic symptoms of disease, he must be familiar with these four laws. The *adequate stimulus* must be understood. Afferent impulses are constantly being carried centralward from the viscera, in conditions of health which result in normal reflex action, but which in conditions of disease result in pathological reflex action. Before such pathological action can be brought about, however, it is necessary for the resistance between the afferent and the efferent nerve components to

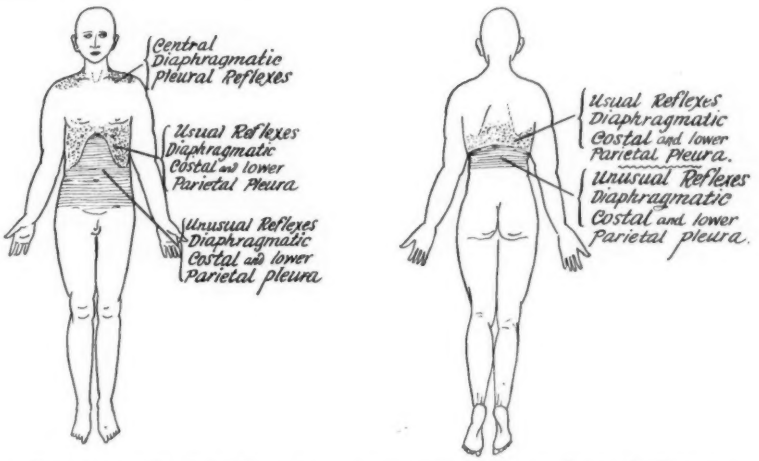

Fig. 4 (A and B). Dotted area above lower costal margin, usual area of reflexes from diaphragmatic costal and lower parietal pleura. Horizontal lines below costal margin, areas to which reflexes from diaphragmatic costal and lower parietal pleura may extend. Dotted area in cervical region, area of reflexes from the central portion of diaphragmatic pleura.

be broken down. This resistance differs in different individuals; consequently, the strength of the impulse necessary to disturb nerve balance and bring about reflex action differs in different individuals. One patient will show a reflex symptom when another under apparently the same circumstance will not.

The second law, the law of Sherrington as modified by myself, explains the location of the reflex but must be considered in connection with the third law in order to explain fully what tissues may be involved in reflex action. For example, angina pectoris as a rule is expressed in the first, second, and third thoracic segments on the left side; but with intense stimuli such as occurs when the attack is unusually severe, it may be transferred to neurons across the cord and be expressed on the right side of the body, or it may be transmitted upward in the cord to the cervical segments and be expressed in those tissues supplied by the cervical nerves; or, less commonly downward into tissues supplied by neurons arising lower in the cord. The same is true with disease of the stomach, liver and gall bladder, appendix, kidney, and every other organ. While there is a definite narrow path through which the reflex is usually expressed, with increased stimulation it may spread upward or downward in the cord and produce reflexes in what would be considered unusual areas if this law were not understood.

The character of the pain expressed when viscera are inflamed has given rise to considerable discussion. The best opinion, however, is that of Ross (7), Mackenzie (4), Head (1), and Lennander (2) and is to the effect that the pain is not expressed in the viscus itself, but in the superficial structures of the body supplied by sensory neurons whose cell bodies in the cord lie adjacent to those of the neurons which are stimulated by the disease in the organ, according to the fourth law above. It is a physiological law that tissues form a defensive mechanism which protects them against all harmful impulses with which they naturally come in contact. But internal viscera, being protected by the superficial structures have been shielded from most ordinary injurious influences, so they are insensitive to many stimuli which cause reaction in the superficial tissues. Viscera, however, are provided with a mechanism by which they express pain and other altered sensation in the superficial structures of the body, the location of which is determined by the segmental nature of the body and the close proximity existing intrasegmentally between

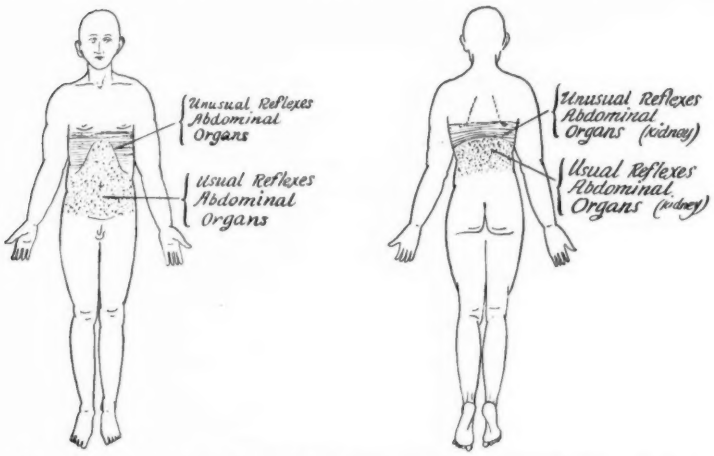

Fig. 5 (A and B). Dotted area below lower costal margin, usual areas of reflexes from abdominal viscera. Horizontal lines above lower costal margin, areas to which reflexes from abdominal viscera may extend.

the neurons which supply the viscera and those which supply the surface of the body.

MOTOR, SENSORY, AND TROPHIC REFLEXES FROM THE DIAPHRAGMATIC AND LOWER COSTAL PLEURA

I shall now attempt to clearly set forth the reflex symptoms which result from inflammation of the diaphragmatic and lower costal segments of the pleura and to show the tissues in which they are usually expressed. At the same time I shall also show how these symptoms, under extraordinary conditions, following the laws of reflexes, sometimes extend to tissues in other areas, particularly over the abdomen and under such circumstance simulate symptoms of disease of the abdominal viscera.

As previously mentioned the diaphragm is a dual organ, being composed of: (1) the crura and central tendon innervated almost wholly by the phrenic nerves which arise from the third and fourth, or fourth and fifth cervical segments of the cord and which produce reflex symptoms, particularly pain, in the neck and shoulders, in those tissues supplied by somatic sensory nerves which arise in the third, fourth, and fifth cervical segments of the cord; and (2) a costal portion innervated almost wholly by the lower six intercostal nerves, which express reflex symptoms in tissues supplied by these same nerves.

The pleura overlying the diaphragm has not only the same innervation of the diaphragm itself, but also is further supplied with sympathetic nerves from the lower six thoracic segments. The lower parietal pleura has the same innervation and the same location of reflexes as the diaphragmatic pleura.

When the lower parietal pleura and the costal portion of the diaphragmatic pleura are acutely inflamed, they produce tension of the intercostal muscles and pain in the tissues which as a rule immediately overlie the seat of inflammation. Under exceptional circumstances both the muscle tension and pain may extend below the costal margin and spread out over the abdomen. If the inflammation passes over into a chronic state and results in adhesions, then atrophy results in those tissues which show muscle tension and pain during the acute stage of the disease. Areas of atrophy of the skin and subcutaneous tissues are commonly found on inspection and palpation overlying pleural segments which have been the seat of chronic inflammation, particularly those which have resulted in adhesions. When one has learned to appreciate the importance of this trophic reflex, he will not be surprised at the recurrent pain of which

these patients complain in the area affected, for the sensory neurons affected become hyperirritable and respond to stimuli of less than normal strength.

Figure 4 (A and B) shows the usual as well as unusual areas involved in reflexes when these portions of the pleura are inflamed. The phrenic nerves supply the crura and central tendon of the diaphragm and possibly send filaments to the overlying diaphragmatic pleura and diaphragmatic peritoneum. It also sends filaments to the capsule of the liver. This must be kept in mind in differentiating inflammation of viscera in this region, as will appear more fully as our discussion proceeds.

It is the reflex symptoms arising from the costal portion of the diaphragmatic pleura and the lower parietal pleura, however, that I wish to discuss more fully in this paper. While each viscus, according to Sherrington's law, has certain tissues in which it expresses its reflexes most readily, yet not uncommonly under great stimulation the area of reflex action is widened so that we often find, in studying inflammation involving the pleura at the base, that the reflexes extend down over the abdominal wall in the areas where abdominal organs regularly express their reflexes.

USUAL LOCATION OF REFLEXES FROM ABDOMINAL ORGANS

Referring to Figure 1, it will be seen that the stomach, liver, pancreas and small intestine are supplied by sympathetic fibers from that portion of the cord between the fifth and the ninth thoracic segments inclusive. On the surface of the body reflexes from these organs are expressed regularly through motor and sensory nerves arising from the fifth to the ninth thoracic segments of the cord inclusive. The preponderant path of the reflexes, as shown in Figure 2, however, is in neurons arising in the sixth and seventh segments, the liver and gall bladder expressing their symptoms on the right side of the body, and the stomach and pancreas on the left. Figure 5 (A and B) shows the usual as well as the unusual location of reflexes for the principal abdominal viscera.

It readily can be seen how a pleurisy arising in the costal portion of the diaphragmatic pleura or the lower parietal pleura might extend down over the abdomen and, expressing increased muscle tension and pain immediately below the costal margin, be mistaken for inflammation in some abdominal organ. This is all the more apparent from the fact that when the liver is involved as when the central tendon of the diaphragm is involved, the pain may extend through the phrenics and be expressed in the neck and shoulder on the right side. Under these circumstances there would be reflex symptoms, probably muscle tension and pain below the right costal border and pain in the shoulder, all of which could be produced either by inflammation of the pleura or inflammation of the abdominal organ. Likewise, on the left side, ulceration of the stomach, particularly if it results in adhesions to the diaphragm, causes not only increased muscle tension and pain in the area immediately below the costal border, but quite often pain in the neck and shoulder on the left side. Acute pancreatitis is accompanied by such intense stimuli that it usually causes a wide-spread area of reflexes extending throughout a great portion of both thoracic and cervical segments. Reflexes arising in these organs are expressed in the same areas as those from the adjoining pleura and at times require careful consideration for their differentiation.

The small intestine reflects most readily in the eighth, ninth, and tenth segments, and the pain is usually expressed around and above the navel. Sometimes inflammation of the lower segments of the pleura will give pain extending into this area.

The appendix and the ascending colon usually show tension of the muscles and pain in the right lower quadrant of the abdomen. Pleurisy on the right side involving the costal portion of the diaphragmatic pleura and the lower parietal pleura not infrequently expresses itself in pain in this same region.

The colon is supplied by sympathetic nerves which arise in that portion of the cord represented by the segments from the ninth thoracic to the third or fourth lumbar inclusive. Pain expressed by the colon varies in its location. It may be on the right side of the body in the upper or lower quadrant; it may be on the left side—either in the upper or lower

quadrant; or, it may be below the umbilicus extending across the abdomen.

Not infrequently do we see inflammation of the lower segments of the pleura giving pain over these same areas. I have frequently seen pain of pleural origin extend down over the abdomen. While I have often seen muscle tension in the upper part of the abdomen below the costal arch resulting from pleurisy, I have never recognized definite muscle tension in the lower abdominal segments.

The kidney receives innervation from that portion of the cord embraced between the tenth thoracic and the third or fourth lumbar segments. The muscle reflex from the kidney as described by me (5, 6) is expressed posteriorly in the lumbar muscles. Pain may be expressed in the lumbar region posteriorly, or in the front of the abdomen below the umbilicus and running down over the upper areas of the thighs. Not infrequently does pain arising in the posterior segments of the diaphragmatic and lower parietal pleura extend down over the same areas in the back as are involved in pain from the kidney.

One must not forget that even the pelvic organs receive part of their innervation from the lower thoracic segments—the tenth, eleventh, and twelfth—as well as from the upper lumbar, and that pain from the pleura may occur in the lower abdominal areas in which the pelvic organs express pain.

SUBACUTE AND CHRONIC PAIN CAUSED BY INFLAMMATION OF THE PLEURA AND ABDOMINAL VISCERA.

In clinical practice the diagnostician often meets patients who are complaining of recurrent pain. It is not necessarily sharp; in fact, most of the time it is dull. The examiner failing to find an acute condition at the time is too apt to consider the subject as a malingerer. In order to understand this type of pain it is but necessary to appreciate the fact that long continued irritation may so injure neurons that they pass into a state of hyperirritability and react (showing pain in the instances under discussion) to a stimulus of much lesser magnitude than that normally withstood. This condition of the neurons may exist for a long period of time, often years, after the acute inflammation has subsided. I see a great many patients who show pain of this type. Unless the condition is properly explained to them they are apt to go from one physician to another, or have one operation after another—all without avail because the underlying facts have not been recognized. Such pain recurs under many different circumstances. In order to grasp what occurs in the production of discomfort in these patients one must realize that the organism is required to adapt itself to every unusual stimulation to which it is subjected. Thus a continuous adaptation takes place during life to such conditions as changes in weather, such as heat, cold, dampness, dryness, wind, calm, light, darkness, fog, and barometric changes; psychical stimuli such as fear, anger, worry, unhappiness and joy, fatigue, overwork, toxins, other effects of disease, the menstrual cycle, and myriads of other conditions that require marked adjustment. Patients who have hyperirritable neurons either generally or in special areas as a result of some previous organic disease adjust but poorly and consequently suffer unduly from discomfort and pain when required to make adjustment. The location of the pain differs with different organs, and in many instances is widespread. The repeated recurrence of the pain is one of the most disappointing and discouraging factors connected with it.

DISCUSSION

I am calling attention to the reflexes which arise when the lower segments of the pleura are inflamed, and showing how they may overlap the areas involved when the abdominal viscera are inflamed, because in studying diseases of the chest I frequently see pleural reflexes which are mistaken for acute abdominal conditions. Every year numbers of patients come under my observation who have been operated on for supposed inflammation of abdominal viscera when the symptoms were due to pleural inflammation. Likewise I see others who, suffering from diseases of the upper abdominal viscera, believe their lungs to be involved because of the pain which they feel over the lower costal areas.

From our discussion it is evident that there are certain muscles or certain parts of muscles

and certain skin and subcutaneous tissue segments which are more intimately connected reflexly with each internal viscus than others; and further, that it is in these particular tissues that each viscus shows the preponderance of its reflexes. It is further evident from the discussion and can be seen in the illustrations that the areas subject to reflexes for each organ are much more extensive than those which usually show the reflexes. If the reflexes arising in each organ were confined to the tissues which are most prone to show reflexes from that organ, there would be little difficulty in recognizing the origin of the stimulation; but unfortunately for diagnosis there is such an intimate correlation and integration of action through the nervous system that reflexes have a tendency to spread to many neurons instead of being confined to those which are most intimately connected with each organ.

If muscle tension and pain were always located above the diaphragm for pleural involvement, and below the diaphragm for inflammation of abdominal viscera, there would be less difficulty of diagnosis; but with the same intercostal nerves supplying the tissues both above and below the costal border the conditions are present for considerable confusion.

Until one has given considerable study to the innervation of these various tissues and familiarized himself with their developmental relationships, it is difficult for him to conceive of how one organ can reflect in a certain muscle or portion of a muscle and not involve other muscles or other portions of the same muscle when the filaments which innervate the entire mass are contained in the same nerve trunk. This is clarified, however, by an understanding of developmental and embryological facts.

I have emphasized above that inflammation of the costal portion of the diaphragmatic pleura and the lower parietal pleura may show reflex symptoms over the abdomen, simulating inflammation of abdominal viscera. It is just as necessary to know that inflammation of abdominal viscera may show reflexes in tissues above the lower costal margin. This is particularly true of the pain reflex (referred pain). Not uncommonly do we find pain over the lower portion of the left side of the chest in patients who are suffering from distention of the stomach with gas, and over the lower portion of the right side of the chest when the patient is suffering from a diseased condition in the liver. The kidney produces pain which is felt over the lower costal areas; so does the descending colon. It is necessary for the diagnostician to understand thoroughly this intimate relationship if he wishes to accurately determine the origin of these reflex symptoms.

There are several acute conditions in which we find the reflex symptoms from the pleura extending over the abdomen which should be especially emphasized, because the symptoms are so apt to lead to operative measures for some supposedly acute abdominal condition at a time when the patient is already seriously ill and unable to withstand the tax of an operation. An instance is the pain which sometimes appears in patients with severe pulmonary hæmorrhage, in which the blood trickles down into the finer bronchi at the base of the lung and settles over the pleura, causing an inflammatory reaction. This condition is often accompanied by acute pain which not infrequently extends downward and is felt over the upper abdomen. If the inflammation is severe, quite frequently tension of the upper abdominal muscles is also present. The same thing occurs occasionally now and then in pneumothorax—either spontaneous or induced—probably as a result of stretching or tearing of adhesions in the lower pleural segments. It is also met now and then in cases of acute pleurisy accompanying pneumonia and in pericarditis.

In calling attention to the confusion which occurs in differentiating supradiaphragmatic and infradiaphragmatic reflexes, and by showing the innervation of the viscera responsible for them and the nerve paths through which they are expressed, and further, by discussing the laws which govern reflex action, it is hoped that differential diagnoses in this important area may be aided.

BIBLIOGRAPHY

1. HEAD, HENRY. Studies in Neurology. London: Oxford University Press, 1920.

2. LENNANDER, K. G. Beobachtungen ueber die Sensibilitaet in der Bauchhoele. Mitt. a. d. Grenzgeb. d. Med. u. Chir., x, Nos. 1 and 2.
3. LUCAS, KEITH. The Conduction of the Nervous Impulse. New York: Longmans, Green & Co., 1917.
4. MACKENZIE, SIR JAMES. Symptoms and Their Interpretation. London: Shaw & Son, 1909.
5. POTTENGER, F. M. Spasm of lumbar muscles; a diagnostic sign. J. Am. M. Ass., 1913, lx, 980.
6. Idem. Symptoms of Visceral Disease. St. Louis, Missouri: C. V. Mosby Company, 1922.
7. ROSS, J. On the segmental distribution of sensory disorders. Brain, 1888, x, 333–344.
8. SHERRINGTON, C. S. The Integrative Action of the Nervous System. New York: Charles Scribner & Sons, 1906.
9. VER WORN, MAX. Irritability. New Haven: Yale University Press, 1913.

THE FREQUENCY OF GASTROJEJUNAL ULCERS

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GASTROJEJUNAL ulcer is undoubtedly one of the most serious of the sequelæ attendant upon gastro-enterostomy. It is in most instances a very painful condition, much more painful than the original ulcer for the relief of which the gastro-enterostomy was performed. In addition to the pains, the patients suffer from mental anguish because of the fact that in spite of their having submitted to a supposedly radical operation for the cure of their gastric or duodenal ulcer, the former symptoms of ulcer have returned in a much more aggravated form. They naturally feel very reluctant to submit to another operation and defer this until the increasing severity of the symptoms compels them to seek again an operative cure.

We know that on account of adhesions secondary operations in the abdominal cavity usually present great technical difficulties. I think it is safe to say that among the secondary abdominal operations those for cure of gastrojejunal ulcer may present the most difficult technical problems. As a rule extensive adhesions of the stomach, large intestine, and omentum to the abdominal parieties and to one another obstruct the access to the gastrojejunal ulcer. Furthermore, many gastrojejunal ulcers are densely adherent to the median colic vessels or have perforated into the transverse colon and in many instances the new ulcer narrows the lumen of the gastro-enterostomy stoma.

These gastrojejunal ulcers were formerly treated more or less conservatively. That is, if the ulcer occupied the anterior or lateral walls of the new stoma, its excision could often be effected without disturbing the posterior margin of the gastro-enterostomy. After such excision, the remaining portion of the stoma, properly enlarged so as to overcome the effects of the stenosis above mentioned and the loss of substance occasioned by the excision, is closed by two rows of sutures. In other instances, when the whole stoma had to be sacrificed, the jejunal opening was closed and a new gastro-enterostomy was established by using part of the jejunum slightly distal to the site of the ulcer. In some cases a temporary jejunostomy was added, in order to insure immediate feeding for these often very debilitated patients.

It was soon found that results following these more or less conservative methods were not satisfactory. Recurrences of gastrojejunal ulcers were by no means infrequent. Among 18 operative cases of gastrojejunal ulcers,[1] which I reported 3 years ago (5), there were 3 *recurrent* gastrojejunal ulcers; and in 1 case there were 2 *recurrences*. In other words recurrence of gastrojejunal ulcer occurred in 16 per cent of the cases after the conservative excision described above. Since the publication of this report another one of these 18 patients was operated upon for recurrent gastrojejunal ulcer, and still another one has returned to the medical service of the hospital with all the clinical evidences of such a recurrence. He refused re-operation. If these 2 cases are added to the 3 others previously

[1] In 5 patients the gastro-enterostomy had been performed in other hospitals.

reported, there are 5 cases (27 per cent) of recurrent gastrojejunal ulcer after excision out of a total of 18 cases, certainly a formidable percentage.

Gastro-enterostomy *per se* has been abandoned by most surgeons in the operative treatment of *gastric* ulcers. The results following such an operation were so unsatisfactory, that during the last 10 years more radical procedures were introduced. These procedures consisted in an excision of the gastric ulcer with or without gastro-enterostomy, sleeve resection, or partial or subtotal gastrectomy.

On the other hand the vast majority of surgeons at the present time consider gastro-enterostomy with or without exclusion to be the method of choice in the treatment of pyloric and duodenal ulcers. In view of the fact that duodenal ulcers are much more frequent than gastric ulcers, gastro-enterostomy still remains the most frequently performed operation for the relief of ulcer. In those cases, where the duodenal ulcer is situated on the anterior wall, an excision is frequently added to the gastro-enterostomy or a Finney pyloroplasty is performed.

There is, however, today a minority of surgeons, small as yet, but increasing in number from year to year, who have been dissatisfied with the results following gastro-enterostomy. They advise a more radical procedure in the treatment of pyloric and duodenal ulcers, namely partial or subtotal gastrectomy. These surgeons had felt for years that gastro-enterostomy failed to cure many patients suffering from duodenal ulcers. Though leaning towards more radical procedures, they feared the possibility of too large a mortality following resection of the stomach. It will certainly always be to Haberer's (3) credit that he showed that the duodenal ulcer can be attacked radically in practically every case and yet the mortality can be kept at about 5 per cent.

Gastro-enterostomy has been used as the method of choice in the treatment of duodenal ulcers for over 30 years. It certainly has had an extensive trial. If the results following gastro-enterostomy had been as good as many surgeons have claimed, it would hardly have appeared necessary to seek more radical procedures. The fact, that this radical party is gradually gaining in strength, points strongly to the conclusion that failures following gastro-enterostomy are very frequent.

It is, indeed, very interesting that support in favor of resection comes from the internist. Many physicians who had occasion to compare the permanent cures following resection of the stomach with the many failures following simple gastro-enterostomy are strong supporters of the resection, and, in those cases which they turn over to the surgeon for operation they prefer resection of the stomach to gastro-enterostomy.

It is generally assumed that the incidence of gastrojejunal ulcers following gastro-enterostomy is about 5 per cent. However, if we analyze statistics dealing with the late results following gastro-enterostomy we find that this figure is really not based on definite data. Many authors are not able to say positively what happened to their patients after an interval of some years. They consider only the few patients who come back to their clinic for re-operation.

In order to settle definitely the question of resection of the stomach versus gastro-enterostomy in the treatment of pyloric and duodenal ulcers, we require a perfect follow-up system. We ought to keep in close personal touch with our patients. They should be seen at frequent intervals during the first year following the operation and at least every 6 months during the subsequent 10 years. Statistics based on communication by letter are of only limited value. Some patients, in answering questionnaires, will overemphasize their complaints, others will make too light of them. It seems impossible to get accurate data about late results except by personal interview with the patient.

On this surgical division we have had a follow-up system for about 10 years. This system is by no means perfect. In spite of the fact that patients know that we are ready to meet them at a fixed hour once a week, many patients do not return and cannot be traced at a later date. To do this work properly, it would require full-time workers, who could keep in constant touch with the patients.

In order to ascertain as far as possible the incidence of gastrojejunal ulcers on this service, we attempted to trace all the patients who had been operated on in this division from 1915 to 1920 inclusive. We did not include in these statistics patients operated upon since 1921, as we felt that definite conclusions could not be obtained from these recent cases. A small number of patients operated upon on other services between 1915 to 1920 and private patients were also not included, as a careful follow-up work would have been too difficult.

During this period (1915 to 1920) nearly all gastric ulcers were treated more or less radically (by excision with or without gastro-enterostomy, sleeve resection, partial or subtotal gastrectomy). *Since* 1917 partial or subtotal gastrectomy has been the method of choice in practically all cases of gastric ulcers admitted to this service. During the same period (1915 to 1920) practically all cases of pyloric and duodenal ulcers were treated with gastro-enterostomy either with or without pyloric exclusion. A few pyloric ulcers were treated by pylorectomy and gastro-enterostomy and a few small duodenal ulcers on the anterior wall were treated by local excision and gastro-enterostomy. These cases are not included in these statistics. We have included here only those cases, in which a simple gastro-enterostomy with or without pyloric exclusion had been performed.

Pyloric exclusion according to Berg's (2) method is performed in the following manner: a double Pagenstecher linen suture, armed with a needle, is carried around the posterior stomach wall and is held in place by taking several bites in the anterior wall. The suture is then tied and the pylorus thus excluded.

Two hundred and thirteen operations of various kinds (local excision, local excision plus gastro-enterostomy, partial or subtotal gastrectomy, sleeve resection, gastro-enterostomy, etc.) for gastric and duodenal ulcers were performed on this service between 1915 and 1920. Twenty-two patients died as a result of the operation, leaving 191 cases available for re-examination. However, only a little less than one-half, i.e. 92 cases, could be studied. The rest could not be located or had moved to other cities. A few had died from other diseases. When the patient could not be located by mail, we sent a social investigator to the last address (given during his stay at the hospital) and traced him, whenever possible, even though he had moved repeatedly.

The patients were re-examined by a group of men (usually 4 or 5) consisting of surgeons and gastro-enterologists. It is of the utmost importance that statistics as to late results should not be tabulated by one man, in order to insure accuracy and eliminate as far as possible the personal element. We classified the patients according to 3 groups: Group I, perfect result; Group II, fair result; Group III, bad result.

Group I contains those patients who have lost everyone of their previous gastric symptoms (pains, heart-burn, nausea, constipation, etc.) and are in the words of Haberer "unconscious of the fact that they have a stomach." Most of these patients have gained considerably in weight (some of them 40 to 50 pounds). They can eat practically any kind of food and need not observe any form of diet.

Patients in the second group, though improved since the operation, are by no means cured. Nausea, heart-burn, and especially constipation is a frequent complaint among these patients. They usually keep a strict diet. Their weight is in most instances stationary since the operation.

We have grouped together in Group III those cases suffering from gastrojejunal ulcers. The symptom-complex is too well known to necessitate detailed description. Suffice it to say that these patients, unless subjected to a second operation, are chronic invalids, unable to do any work. They may have intervals of remission of their symptoms. However, these intervals are usually of short duration. This group can well be considered as a complete failure from the standpoint of gastro-enterostomy.

It may seem peculiar that our third group contains only gastrojejunal ulcers. But every one of our total failures during the period under discussion was shown either by clinical methods or by re-operation to be due to gastrojejunal ulcer.

Table I shows the late results obtained on this service following gastro-enterostomy.

TABLE I. LATE RESULTS IN SIXTY-EIGHT CASES OF GASTRO-ENTEROSTOMY WITH OR WITHOUT PYLORIC EXCLUSION

	Number of Cases	Per cent
Group I—perfect	32	47
Group II—fair	13	19
Total	45	66
Group III—gastrojejunal ulcers		
Subjected to second operation	12	18
Not subjected to second operation	11	16
Total	23	34

TABLE II. LATE RESULTS IN FIFTY-TWO CASES OF GASTRO-ENTEROSTOMY WITH PYLORIC EXCLUSION (BERG'S METHOD).

	Number of Cases	Per cent
Group I—perfect	26	50
Group II—fair	9	17
Total	35	67
Group III—gastrojejunal ulcers		
Subjected to second operation	10	19
Not subjected to second operation	7	14
Total	17	33

TABLE III. LATE RESULTS IN SIXTEEN CASES OF GASTRO-ENTEROSTOMY WITHOUT PYLORIC EXCLUSION

	Number of Cases	Per cent
Group I—perfect	6	38
Group II—fair	4	25
Total	10	63
Group III—gastrojejunal ulcers		
Subjected to second operation	2	12
Not subjected to second operation	4	25
Total	6	37

Gastro-enterostomy with or without exclusion effected a perfect cure in nearly 50 per cent of our cases. It is generally assumed that gastro-enterostomy in about two-thirds of the cases yields a perfect result with disappearance of all symptoms. Our smaller figures are probably due to the very careful follow-up study and also to the fact that we have only included cases that were operated upon 9 to 4 years ago.

If we combine Group I and Group II we have 66 per cent of perfect and fair results. It must be stated, however, that some of the patients in Group II were far from being cured. Though they showed considerable improvement after the operation, many of their old symptoms persisted or recurred.

Among the 23 cases of gastrojejunal ulcers 12 (18 per cent) were subjected to a second operation. In these cases the correctness of the diagnosis was established by a secondary operation. The diagnosis in the remaining 11 cases (16 per cent)[1] is based on clinical symptoms and X-ray findings. We know that the X-ray diagnosis of gastrojejunal ulcers in the hands of experts is correct in at least 90 per cent of the cases. If clinical symptoms and X-ray findings both point to a gastrojejunal ulcer, the diagnosis is practically certain. No case was included in this series in which X-ray findings did not show the presence of a gastrojejunal ulcer. In fact it is possible that some patients counted in Group II really belong to Group III (gastrojejunal ulcers).

We were interested to know whether pyloric exclusion, as has been stated, increases the incidence of gastrojejunal ulcers. For instance Haberer (4) observed 12 gastrojejunal ulcers among 71 patients (17 per cent), in whom an Eiselsberg exclusion had been performed. In fact the investigation of this point was one of the reasons why this study was begun. The results of gastro-enterostomy with or without Berg's exclusion are shown in Tables II and III. Late results following these two procedures are practically identical. Simple exclusion of the pylorus according to Berg's method does not increase the incidence of gastrojejunal ulcers.

We are well aware of the fact that our statistics for gastrojejunal ulcers are very high, as compared to other statistics. The high percentage is probably explained by the *careful personal re-examination* of the patients for years (4 to 9) after the primary operation.

It might be said that we only kept in touch with our surgical failures. The argument might be advanced that in the course of years most of the patients, who were perfectly well, failed to return to the clinic, whereas those who were suffering from recurrence of symptoms came back to the return clinic for relief. It is erroneous to assume that the vast majority of patients who do not return to the clinic in the course of years are necessarily cured cases. We know from letters received, that a number of patients went to other hospitals for

[1] These cases refused operation.

relief of recurrences. Some patients go elsewhere rather than return to the institution where the primary operation failed to cure them. Furthermore we have confined our report, as stated above, strictly to patients who were re-studied. For instance, we did not include a patient who according to a report received from a surgeon in China, was operated upon for perforated gastrojejunal ulcer. In other words, we think that if all of the 192 available cases had returned for re-examination, the relative proportion of successes and failures would not have been changed materially.

The argument might be advanced that the high percentage of gastrojejunal ulcers, as reported above, is due to faulty technique in the performance of gastro-enterostomies. However, we are sure that our technique in performing a no-loop retrocolic posterior gastro-enterostomy does not differ in any essential point from that in general use. We have always used rubber-covered clamps, in order to avoid injury to the stomach or intestine. Pagenstecher linen thread was used for the outer and chromic gut for the inner suture line. For a number of years I have used chromic catgut for both layers. Since 1921 I have used Luken's specially prepared catgut with needle attached, when performing gastro-enterostomy. This needle and thread are united in such a manner that injury to the mucosa, when passing through the tissues, is minimized considerably. Yet with all these refinements in technique the incidence of gastrojejunal ulcers was not reduced.

We have always felt that the kind of suture material plays a very unimportant factor in the occurrence of gastrojejunal ulcers. Though non-absorbable suture material may be found in rare instances in re-operations for gastrojejunal ulcers, such finding is purely accidental and does not represent a causative factor for the etiology of the ulcer at or near the gastro-enterostomy. In the 21 cases of gastrojejunal ulcers which I reported in 1921 (5) no remnant of suture material was found, though the vast majority of these gastro-enterostomies had been performed with a Pagenstecher linen thread for the outer layer.

Trauma as a causative factor for the occurrence of gastrojejunal ulcers has been overrated. For instance, among the re-examined patients were 5 in whom, on account of extensive adhesions between the posterior wall of the stomach and the posterior parieties, the Murphy-Weir button had been used. Undoubtedly uniting the two halves of the button, followed by secondary sloughing of the tissues caught in the button, means a considerable trauma to the tissues at the site of the stoma. Yet all these 5 cases, when re-examined lately, were perfectly well (Group I). Naturally we do not want to infer that a button is preferable to a suture gastro-enterostomy. However, it seems evident from these observations that trauma is a negligible factor in the formation of gastrojejunal ulcers.

We cannot agree with Sherren (8) who claims that patients who have been well for 2 years following a gastro-enterostomy for duodenal ulcer can be considered as permanently cured. In looking over our records we found a number of cases in which patients had been absolutely free from any symptoms for 5 years. Yet they developed gastrojejunal ulcers after this lapse of time. For this reason it is possible that in some cases, now placed in Group I and counted as cured, gastrojejunal ulcers may develop at a later date.

These 92 cases, which were re-examined during the last 6 months, were all subjected to another test-meal. Results of this investigation as to acidity following resection of the stomach and gastro-enterostomy with or without pyloric exclusion will be published in a separate paper in the near future. Suffice it to state here that in practically all cases of resection a condition of anacidity supervenes immediately and continues even after the lapse of many years. On the other hand the acidity of the gastric juice is practically unchanged following gastro-enterostomy with or without pyloric exclusion (Berg's method).

These findings, which confirm Lorenz and Schur's (6) recent investigations along the same lines, offer a strong argument in favor of primary resection of the stomach, not only when gastric ulcers, but also when pyloric and duodenal ulcers are being dealt with. Whatever the real etiology of ulcers may be (infection, embolism, or other source), experi-

ence has shown that hyperacidity is a contributory factor in the growth of these ulcers. We have only one operative method at our disposal which makes a hyperacid stomach permanently anacid, i.e. partial or subtotal gastrectomy. A gastrojejunal ulcer following resection of the stomach is an extreme rarity. Gastric resection has been practiced on this service for many years in the treatment of gastric ulcers. We have never seen a gastrojejunal ulcer following partial or subtotal gastrectomy. However, 3 cases of gastrojejunal ulcers following pylorectomy (Billroth II) were observed in this hospital.[1]

The Murphy button which has been used in these 3 cases of pylorectomy cannot be blamed for the occurrence of the gastrojejunal ulcers because up to about 2 years ago the button was used extensively on this service in cases of partial or subtotal gastrectomy, yet we have never seen a gastrojejunal ulcer following a partial or subtotal gastrectomy. Furthermore, as stated above, 5 cases of simple gastro-enterostomy, performed with the aid of the button, are now in Group I. In other words, if we succeed in producing a permanent anacidity by our operative method, a gastrojejunal ulcer is not apt to occur. Whether the gastro-enterostomy was established by suture or by a button does not matter. However, pylorectomy or simple gastro-enterostomy with or without pyloric exclusion may be followed by a gastrojejunal ulcer in a large percentage of the cases. The important factor in the prevention of subsequent gastrojejunal ulcers seems to be the anacidity, not the technique of the anastomosis.

At the present time with the exception of the superficial ulcer, the treatment of gastric or duodenal ulcers must be surgical. Operative interference ought to guarantee a permanent cure to the patient. Gastro-enterostomy which cures permanently only half (or possibly slightly more) of the pyloric and duodenal ulcers is not an ideal method, especially if we consider that any patient thus treated may be subject at a later date to a gastrojejunal ulcer.

Resection of the stomach on the other hand seems to cure the vast majority of these patients permanently. It cannot be denied that this operation is more formidable than simple gastro-enterostomy. However, the mortality (between 5 and 10 per cent according to different statistics) is not excessive and not greater than that following gastro-enterostomy (according to the average statistics).

Furthermore, primary resection of the stomach will practically abolish the occurrence of gastrojejunal ulcers. As stated above, gastrojejunal ulcers present one of the most difficult technical problems in abdominal surgery. The high percentage of recurrences even after local excision (see above) makes it imperative to deal with these ulcers radically. We agree with Balfour (1) who stated recently that "partial gastrectomy is the method of choice in the majority of gastrojejunal ulcers." However, it is obvious that this operation will always be a very formidable procedure, as patients suffering from gastrojejunal ulcers are poor operative risks.

Deaths following operations for gastrojejunal ulcers should really be tabulated as late deaths following gastro-enterostomy. In this case, the mortality following gastro-enterostomy would probably be higher than the mortality following primary resection of the stomach in gastric and duodenal ulcers.

Gastro-enterostomy for pyloric and duodenal ulcers has been practically abandoned on this service. During the last 18 months less than half a dozen gastro-enterostomies were performed on patients in whom strict contra-indications (diseases of heart and lungs, etc.) made resection inadvisable. In addition, one member of the staff performed 2 Finney pyloroplasties. With the exception of these few cases, resection of the stomach has been the method of choice not only in chronic gastric and duodenal ulcers, but also in gastrojejunal ulcers. Results up-to-date have been very satisfactory. We feel that this operation practically guarantees the patient a permanent cure.

There is certainly a great deal of truth in the statement, "Gastro-enterostomy is a disease" (7). We think that in the course of the next ten years partial or subtotal gastrectomy will gradually supplant gastro-enterostomy in the treatment of chronic pyloric and duo-

[1] Two patients were operated upon by Dr. A. A. Berg, 1 by Dr. Wilensky.

denal ulcers in the same way that cholecystectomy has been substituted for cholecystostomy in the surgical treatment of cholelithiasis.

CONCLUSIONS

1. Gastrojejunal ulcers are a frequent occurrence after gastro-enterostomy.

2. In our series of 68 cases re-examined 4 to 9 years after gastro-enterostomy 47 per cent were completely cured and 19 per cent had a fair result.

3. Thirty-four per cent suffered from gastrojejunal ulcers. In 12 cases (18 per cent) a second operation was performed. In 11 cases (16 per cent) the diagnosis was based on clinical symptoms and X-ray findings.

4. Pyloric exclusion according to Berg's method does not increase the incidence of gastrojejunal ulcers.

5. Gastro-enterostomy does not reduce the hyperacidity even after many years, whereas resection of the stomach effects an immediate and permanent anacidity in the majority of cases.

6. Partial or subtotal gastrectomy safeguards against later occurrence of gastrojejunal ulcers. It should, therefore, be the method of choice in the surgical treatment of chronic gastric and duodenal ulcers.

7. Partial or subtotal gastrectomy should be the method of choice in the surgical treatment of gastrojejunal ulcers. Application of conservative methods (local excision, etc.) is followed by too many recurrences. In 27 per cent of the cases there were recurrences according to our statistics.

BIBLIOGRAPHY

1. Balfour. Partial gastrectomy for gastrojejunal ulcer. Ann. Surg., 1924, lxxix, 386.
2. Berg. The influence of gastro-enterostomy on gastric and duodenal ulcers. J. Am. M. Ass., 1913, lx, 881.
3. Haberer. Anwendungsbreite und Vorteile der Magenresektion Billroth I. Arch. f. klin. Chir., 1920, cxiv, 127.
4. Idem. Zur Frage des Ulcus pepticum jejuni auf Grund aelterer und neuerer klinischer Erfahrungen. Arch. f. klin. Chir., 1922, cxix, 712.
5. Lewisohn. Gastrojejunal and jejunal ulcers. J. Am. M. Ass., 1921, xxxvii, 442.
6. Lorenz and Schur. Unsere Erfahrungen ueber den Wert der Antrumresektion bei der Behandlung des Ulcus pepticum. Arch. f. klin. Chir., 1922, cxix, 239.
7. Pribram. Die Gastro-enterostomie als Krankheit. klin. Wchnschr., 1923, ii, 1542.
8. Sherren. Disease of the stomach and its surgical treatment. Lancet, 1924, 477.

THE EFFECT OF SURGICAL TRAUMA, IN PATIENTS WITH SYPHILIS, WITH SPECIAL REFERENCE TO HEALING OF THE POSTOPERATIVE WOUND

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THE traditional teaching with reference to surgery for the patient with syphilis is expressed by Gibbon as follows: "Syphilis either hereditary or acquired is capable of greatly interfering with good postoperative results. If, however, we take the precaution to give the patient proper antisyphilitic treatment for some time before and after operation the results will be perfectly satisfactory." This rather dogmatic statement can be accepted only with proper reservations. The experienced syphilographer, who has had an opportunity to see surgical operations performed on his patients, under a variety of conditions, will at once question the desirability of routine treatment for syphilis. It is quite apparent that in the late form of the disease the type of visceral involvement may modify the postoperative course, even when proper treatment has been carried out. Gellhorn calls attention to the not uncommon observation that a patient with unrecognized syphilis makes an unusually smooth recovery following operation. Because of the importance of such considerations, a survey of the material at the Mayo Clinic was undertaken.

1. Records of 78 patients, known to have syphilis, were examined with special reference to the postoperative course.

2. Five thousand unselected surgical records were studied with reference to the incidence of syphilis, the number of patients suspected of having syphilis, and the postoperative difficulties probably attributable to syphilis in retrospect.

The group of 78 cases in which operation was performed was collected from the files of the Section on Dermatology and Syphilology after a diligent search. No case was included in which the diagnosis of syphilis was not fully established. Tonsillectomies, alveolectomies, venupunctures and lumbar punctures in treated patients, and those major operations in which the record did not definitely state the postoperative course, were disregarded. Minor operations are performed daily with impunity on patients treated for syphilis. Incomplete records, of course, contribute nothing to the settlement of the problem at hand. Of the 78 patients, 50 had received some treatment for syphilis (Table I) either before or directly after operation; 28 had not been treated.

In only one of the patients in the treated group was there any postoperative difficulty in the healing of the wound. This occurred in an extensive resection for cancer of the breast. The infection was evidently pyogenic; the coaptation of the wound was difficult, and the patient's general resistance low. Treatment for syphilis did not stimulate healing. In all the other patients treated the wound healed uneventfully, and there was no evidence of pyogenic infection, gangreme, gummatous infiltration in the wound, or any other postoperative difficulty. That these should not develop complications attributable to syphilis was to be expected; it only emphasizes the experience of others. Only one instance of difficult healing in 50 operations, the majority of a formidable character, argues for the excellence of the surgical technique, and the probable value of treatment for syphilis. It is doubtful if an unselected group of patients without syphilis could yield any better postoperative results. It was, on the other hand, strikingly apparent in 3 cases of this group that treatment before or after operation will not always assure "perfectly satisfactory results." These 3 patients died shortly after operation. A brief abstract of each case follows:

Case 1. R. B., a man, aged 38 years, had chronic empyema when he came to the Clinic. His general health was very poor, as the result of the chronic toxic condition. A Wassermann test was strongly positive. He was given six doses of neo-arsphenamin,

1 to 4 decigrams to the dose. His general condition seemed to improve, but only temporarily. Thoracotomy was finally resorted to as the only hope for relief. The patient died a few days after operation.

CASE 2. P. A., a woman, aged 42 years, had cancer of the right breast with marked glandular involvement. The Wassermann test on the blood was strongly positive, the cerebrospinal fluid revealed Wassermann reaction positive with 0.4 and 1 cubic centimeter; Nonne test positive, and cells 3. Two doses of 3 decigrams of arsphenamin were given, and a radical amputation of the breast was performed. The patient died from cerebral embolism 15 days after operation. The surgical wound healed uneventfully. Necropsy disclosed an extreme degree of generalized arteriosclerosis and the embolic accident.

CASE 3. P. C., a man, aged 45 years, had an abdominal aneurysm, which was not recognized clinically. On exploratory incision it was thought advisable to perform cholecystectomy and appendectomy. The Wassermann reaction was strongly positive and the cerebrospinal fluid negative. Two doses of arsphenamin of 3 and 4 decigrams and 4 intramuscular injections of mercury succinimid ⅙ grain to the dose, were given before the operation. The patient died suddenly from rupture of the aneurysm 14 days after the operation.

It is apparent that these patients not only needed treatment for vitiated blood and tissues which might interfere with their recuperative powers, but they had sustained an injury to vital structures that placed them in the same category with similar diseases due to other infections. Their general physical vigor really determined their operability. The first patient had very poor general health, the result of a toxic condition from chronic empyema. The critical condition of the patient was fully recognized and thoracotomy was hesitatingly performed as a palliative measure. Syphilis contributed nothing tangible to the fatal outcome. Treatment for syphilis could not, therefore, be expected to have influenced the surgical result. The second patient urgently required the operation. A rapidly progressing cancer of the breast with glandular involvement prohibited prolonged treatment for syphilis prior to operation, and this probably would not have changed the outcome. The marked arteriosclerosis, especially of the brain, made this patient a poor operative risk no matter whether these changes were due to syphilis or some other cause. In this particular case the full extent of arteriosclerosis was determined only on postmortem examination. Had it been possible to recognize clinically the degree of injury to the vessels, it is not likely that an operation would have been performed. The factor deterring the surgeon would not have been syphilis as an infection, but rather the resultant vital injury. The third patient presented a diagnostic puzzle. Obscure abdominal symptoms led to an exploratory laparotomy. The cholecystectomy and appendectomy made it a fairly formidable procedure. Recognition of the abdominal aneurysm at the time of exploration would have prevented further interference. There was nothing present to warrant major surgical interference. Had the aneurysm been recognized clinically, even a laparotomy would not have been performed. How much the shock of the operation contributed to the fatal issue must remain doubtful. It was an instance of poor surgical risk, because of a damaged vital structure, whose nature was not correctly diagnosed.

These 3 patients emphasize again the desirability of a complete study of a patient with syphilis, as pointed out by Stokes. A Wassermann test on the blood is not sufficient. In fact, it is in the later stages of the disease, when the serologic tests are often negative that a scrutinizing physical examination, especially of the vascular and nervous system, is indicated. This is of vital importance when the patients are to undergo an operation, as is demonstrated by these 3 cases. Cases 2 and 3 raise the question of whether treatment for syphilis may not, at times, do more harm than good. These patients had had only enough treatment to produce a Herxheimer reaction in a gummatous infiltrate. Whether this reaction was responsible for their hastened end is problematic. That such a danger is very real, however, should be recognized. It is possible that a moderate amount of treatment, especially arsphenamin before operation, may be harmful and should not be used in a haphazard manner. This is no argument against careful systemic treatment for syphilis when surgical indications permit. A patient who has sustained damage to one of his vital organs from his syphilitic infection may, by systematic treatment, including such general

medical measures as may be indicated in the individual case, be made a much better surgical risk.

Twenty-eight patients with syphilis were operated on without treatment for reasons as follows: (1) syphilis was not recognized at the time of operation; (2) the patient ignored advice as to the desirability of treatment; (3) the operation was performed as an emergency, and (4) at the time of operation syphilis was considered a minor matter in comparison with the surgical lesion. Certain features of general interest in this group are shown in Table II.

Five of the untreated patients had distinct difficulty with the healing of wounds. In two instances gummata were directly incised; in one the gumma involved the ankle and presented a classical picture of late cutaneous syphilide. It was, however mistaken for an abscess by the patient's local physician. An attempt to drain resulted in further sloughing. The wound healed promptly under treatment for syphilis, with more than the necessary amount of scarring. In another case a gumma of the thyroid gland pressing on the trachea, presented a puzzling picture. Gumma was not suspected and, therefore, an exploratory incision was made before a Wassermann test. Examination of the tissue pathologically suggested syphilis, and a test immediately after the operation gave a positive blood Wassermann reaction. The gummatous lesion perforated into the trachea, probably aided by the surgical trauma inflicted. Although the ulcer healed promptly under treatment, the amount of scarring was sufficient to interfere seriously with the patient's ability to speak. Such errors in diagnosis serve to emphasize the importance of raising the index of suspicion for syphilis to the highest degree. In a third case enlarged cervical glands were excised, and on healing, the postoperative scar became markedly infiltrated. It is probable that in this instance, also, gummatous tissue was traumatized by the surgeon's knife. The poor results in these 3 cases must be attributed to surgical error, and cannot be used as a general argument to stamp all patients with syphilis, as such, as poor surgical risks. The course of events is not so clear concerning the last 2 patients in this group. A local physician had made an abdominal incision on one patient, ostensibly for operation on the gall bladder. No record was made of the lesion found. The wound, however, did not heal, and when the patient was seen at the Clinic, a classical nodulo-ulcerative syphilide presented itself in and around the wound. Under treatment for syphilis she recovered promptly. An amputation had been performed on the fifth patient after a crushing injury to the leg. The stump did not heal under ordinary surgical measures, but healed gradually under treatment for syphilis. The patient gave a history of a syphilitic infection, but the blood Wassermann reaction and the spinal fluid examinations were always negative.

Among the 5 patients in the untreated group whose wounds did not heal satisfactorily were 3 whose gummatous lesions had been directly traumatized. The difficulty with such a wound is none other than a needless interference with a disease process. It is no more justifiable than improper surgical intervention with a tuberculous focus. A gummatous infiltration in itself is probably no longer considered a surgical disease, and only a mistaken diagnosis can explain the application of a knife to a gumma, except in exceptional instances. The last two patients of this group may favor the belief that the tissues of the patient with syphilis heal poorly without treatment. This being granted, 2 of the 28, or about 7 per cent of the untreated patients, had difficulty with their postoperative wounds. The first 4 patients belonged to a group of 10 of the 28, who had not received treatment for syphilis. At the time of operation on these 10 patients the surgeon was not aware of the syphilitic infection, because no blood Wassermann test had been made; they all reacted positively when subsequently examined. Four of the patients had postoperative difficulty; 6 did not. A routine application of the Wassermann test would have materially contributed to the general management of these patients, and probably have spared a number of them operations which could have been avoided.

That a patient with syphilis, even if not treated, need not necessarily be a poor operative risk was illustrated strikingly by a number

of patients in the series studied. Abstracts of their histories follow:

CASE 4. W. T., a man, aged 49 years, was given a diagnosis of syphilis on his first visit to the Clinic. The blood Wassermann reaction was strongly positive, and the spinal fluid test revealed a positive Wassermann with 0.2, 0.3, 0.4, and 0.5 cubic centimeter; Nonne positive, and lymphocytes 72. The patient ignored the suggestion that he be treated for syphilis. Several months later he came again to the Clinic with an epithelioma of the cheek and involvement of the cervical glands. The epithelioma was cauterized and a block dissection of the glands performed. The wounds healed uneventfully. No treatment for syphilis was given. A year later the cancer had not recurred.

CASE 5. P. M., a man, aged 45 years, had had an exploratory incision about 2 years before, because of an enlarged liver. At this time masses suspected of being metastatic cancers were found in the liver. Microscopic examination of excised tissue did not confirm this suspicion. No Wassermann test was made on the blood because syphilis evidently was not suspected. Because of the possibility of cancer, deep X-ray and radium treatment was systematically applied at regular intervals. There were no ill effects from the operation. Recently, this patient began to have further trouble. Syphilis was suspected, a blood Wassermann test was made, and the reaction found to be positive. The masses found in the liver at operation were probably gummata.

CASE 6. R. G., a man, aged 49 years, had had permanent colostomy more than 3 years before for cancer of the rectum. The diagnosis was confirmed by microscopic examination. No Wassermann test was made at the time of the operation. Two years later the patient developed gumma of the palate with a strongly positive Wassermann reaction on the blood. The colostomy opening remained in good condition. The gumma healed rapidly under treatment for syphilis. X-ray and radium treatment kept the rectal cancer well under control. The danger to the patient is not that the neglect to treat him for syphilis will affect the operative result, but that his syphilis will progress with other and graver later manifestations.

My observation that the untreated patient with syphilis is not of necessity a poor surgical risk as such, and that there is not likely to be any complication involving the postoperative wound, in more than 7 to 10 per cent of cases, seems to be borne out by Darnall. He asserts that in his own experience which covered an active service of about 20 years, he observed only 3 cases of delayed healing of abdominal wounds, as the result of syphilis. Two of these patients he believed were definitely syphilitic, and the third was probably syphilitic. It

TABLE I. SUMMARY OF FINDINGS IN FIFTY CASES TREATED BEFORE OR AFTER OPERATION

Sex	Cases
Males	31
Females	19
Total	50

Age	Years
Youngest	6
Oldest	60
Average	39

Types of syphilis	Cases
Latent	20
Neurosyphilis	13
Cutaneous	4
Vascular	4
Osseous	4
Heredosyphilis	3
Hepatic	3
Gumma of testicle	1

Wassermann Reaction on blood	
Positive	39
Negative	11

Cerebrospinal fluid in 11 negative Wassermann reactions on blood	
Positive	5
Negative	6

Treatment

	Smallest amount	Largest amount	Average*
Arsphenamin	1 dg.	4 gm.	1.9 gr.
Neo-arsphenamin	3 dg.	10 gm.	2.2 gr.
Intramuscular mercury succinimid	0.67 gr.	8 gm.	2.0 gr.
Mercury inunctions (P. P. Motts)	6	137	47

Iodides were given in moderate amounts to certain patients, exact amount not known in any case.

Time of infection in males and females

	Males	Females
Unknown	12	14†
Shortest, year	2.5	6
Longest, years	34	14
Average, years	15	5

*This can be estimated only approximately because the amount of medication in every case is not exactly known. The average amount of treatment employed means the amount of the drug given on an average in 44 cases in which the dosage was known.

†Suggests low value of history of syphilis in females; there was no knowledge of infection in 14 of 19 in this group.

Lesion	Operation	Cases
Duodenal ulcer and chronic appendicitis	Posterior gastro-enterostomy and appendectomy	2
Gastric ulcer	Excision of ulcer and posterior gastro-enterostomy	1
Right direct inguinal hernia	Herniotomy	1
Atropic uterus, bilateral salpingitis	Total hysterectomy and salpingectomy	1

Lesion	Operation	Cases
Stone in left kidney	Posterior pelviolithotomy	1
Left inguinal hernia	Modified Andrews—Bassini herniotomy	2
Chronic cholecystitis and chronic appendicitis	Cholecystectomy and appendectomy	2
Large supra-umbilical hernia	Herniorrhaphy	1
Duodenal ulcer	Posterior gastro-enterostomy..	1
Abscess of left breast in course of chronic mastitis	Simple amputation and drainage	1
Right indirect inguinal hernia	Andrews-Bassini herniotomy	1
Adherent phimosis	Circumcision	1
Adenomata in large colloid goiter	Thyroidectomy	1
Varicose veins of both legs	Long saphenous vein stripped and dissected out	1
	Ligation through multiple incisions	1
Multiple fibromata of uterus	Subtotal abdominal hysterectomy	1
Large internal hæmorrhoids	Hæmorrhoidectomy by clamp and cautery	1
Foreign bodies in elbow joints	Removal of foreign bodies, and hypertrophied bone chiseled off	1
Cancer of the breast	Amputation of the breast, Halsted	1
Rectovaginal fistula	Elting operation for recurrent fistula	1
Left tubo-ovarian abscess, right hydro-salpynx, chronic appendicitis	Bilateral oophorectomy and salpingectomy, appendectomy	1
Large abscess with enlarged pectoral gland	Incision of abscess and drainage of gland	1
Complete prolapse of cervix and vagina, marked cystic cervicitis, lacerated perineum	Modified Bovee operation, Law amputation of cervix, perineorrhaphy	1
Chronic cholecystitis and appendicitis	Cholecystectomy and appendectomy	1
Duodenal ulcer and chronic appendicitis	Posterior gastro-enterostomy and appendectomy	1
Cancer of the right breast with marked glandular involvement	Radical amputation of the right breast	1
Trifacial neuralgia	Resection of posterior left root of gasserian ganglion	1
Cancer of the stomach	Exploration	1
Gumma of the testicle	Exploration	1
Syphilitic cirrhosis of the liver with ascites	Paracentesis repeated three times	1
Multiple fibromyomata of uterus	Total abdominal hysterectomy, oöphorectomy, and salpingectomy	1
Urethral stricture	Cystostomy and dilatation of stricture	1
Nonunion of a fractured tibia	Fixation of beef-bone plates	1
Colloid adenoma of the thyroid	Resection of right lobe with removal of isthmus	1
Old empyema	Thoracotomy	1
Bilateral hydrocele	Modified Sic operation on both sides	1
Appendicitis, acute ventral hernia	Appendectomy; herniorrhaphy	2
Phlegmon of left upper cervical region	Incision and drainage	1
Gumma of the liver	Exploration, excision of piece of tumor and liver for diagnosis	1
Cancer of the left breast	Radical amputation	1
Cholecystitis and chronic appendicitis	Cholecystectomy and appendectomy	1
Leather bottle stomach resulting from syphilitic scarring	Partial gastrectomy; posterior colic	1
Postoperative biliary fistula	Removal of tube	1
Chronic appendicitis	Appendectomy	1
Left infected hydronephrosis	Nephrectomy	1
Adenoma of the thyroid	Partial thyroidectomy	1
Epithelioma of the lip with glandular involvement	Excision of epithelioma with block dissection of glands	1

TABLE II. SUMMARY OF FINDINGS IN TWENTY-EIGHT CASES NOT TREATED BEFORE OPERATION

Sex

	Cases
Males	12
Females	15

Age

	Years
Youngest	7
Oldest	53
Average	40

Types of syphilis

	Cases
Latent	11
Neurosyphilis	9
Hepatic	3
Heredosyphilis	1
Vascular	1
Gastric	1
Cutaneous	1
Osseous	1

Wassermann reaction on blood

Positive	22
Negative	5

Cerebrospinal fluid in 5 negative Wassermann reactions on the blood

Positive	2
Negative	3

Time of infection

Unknown	24
Known (3, 4, 17, and 20 years)	4

TABLE II.—Continued

Lesion	Operation	Cases
Cirrhosis of the liver	Talma-Morrison	1
Multiple gummata of the liver.	Exploration	1
External and internal hæmorrhoids	Clamp and cautery for internal and ligation and excision for external hæmorrhoids	1
Cancer of the rectum	Permanent colostomy	1
Fibroids of uterus and cysts of ovary	Hysterectomy and oophorectomy	1
Pyonephrosis with nephrolithiasis	Left nephrectomy	1
Hodgkin's disease	Extensive block dissection of cervical glands	1
Epithelioma of the cheek with enlargement of cervical glands	Cauterization of epithelioma and block dissection of glands	1
Multiple gastric ulcers and subacute appendicitis	Cautery and excision of ulcers, posterior gastro-enterostomy, appendectomy	1
Removal of piece of muscle tissue	for biopsy	1
Infected stump	Amputation of thigh	1
Epithelioma of the lip	Excision of epithelioma and block dissection of cervical glands	1
Cholecystitis and chronic appendicitis		
Cancer of the breast	Radical amputation	1
Cystadenoma with cancer of the ovary	Repeated resection for recurrence	1
Stones in the bladder	Suprapubic cystostomy with removal of stones	1
Gumma of the ankle	Incision	1
Gumma of the thyroid	Exploration	1
Cholecystitis (?)	Abdominal incision	1
Gastric crises	Fixation of uterus and gastro-enterostomy	1
Exophthalmic goiter	Thyroidectomy	1
Large septic tonsils	Tonsillectomy	1
Gummata of the liver	Exploration	1
Cholelithiasis	Cholecystectomy	1
Abdominal adhesions	Exploration and separation of adhesions	2
Duodenal ulcer; chronic appendicitis and adenomata of the thyroid	Appendectomy, posterior gastro-enterostomy, partial thyroidectomy	
Cervical adenopathy	Resection of the glands	1

would seem strange if this author had not operated on many more patients with syphilis than the few he observed with complications, especially since a considerable number evidently were colored.

We have, then, accumulated considerable evidence to show that the wounds of patients with syphilis heal quite satisfactorily, but a careful study of the patient previous to operation is none the less essential. It will contribute to a better management of the case, and often, through judicious treatment, make the patient a better risk, or do away with the need for operation entirely.

THE POSTOPERATIVE COURSE IN 5000 UNSELECTED SURGICAL CASES

Five thousand unselected surgical records were examined chiefly in the hope of adding a reasonable number of cases of untreated syphilis in which the patients were operated on, to those recorded in the files of the Section on Dermatology and Syphilology. Only 23 (0.46 per cent) were found in which a diagnosis of syphilis had been made. In 1,498 cases (30 per cent) the Wassermann reaction on the blood was negative, and in 3,479 (70 per cent) no Wassermann test had been made. In other words, in 70 per cent of these cases investigation for the possible presence of syphilis had not proceeded even as far as a Wassermann test. In none was there postoperative difficulty attributable in retrospect to syphilis.

Stokes and Brehmer found that more than 3 per cent of the patients entering the Clinic are syphilitic. In the series of 5,000 cases considered here, a diagnosis of syphilis was made in only 23 cases (0.46 per cent). This is about one-seventh the number of syphilitic patients registering at the Clinic, as estimated by Stokes and Brehmer. But since syphilis was considered in less than one-third of the patients, as shown chiefly by the number of Wassermann tests made, it is probably safe to say that in a considerable number syphilis was not recognized. In other words, if the fact can be accepted that the percentage among the surgical patients is as high as among all the registrants at the Clinic, about 161 instead of 23 patients with syphilis should have been found. This proportion will probably not hold, as a reasonable number of registrants are frankly syphilitic. The very low percentage (0.46 per cent), however, must probably be attributed to a lack of suspicion, as in 3,479 of the series of 5,000 not even a Wassermann test was made, to say nothing of any further search for evidence of syphilis. It

would seem likely that the routine employment of the blood Wassermann test would have ferreted out a considerable number of patients with syphilis in this series. Routine application—of the test before surgery is undertaken—is, therefore, desirable, if only to avoid complications in a small number of cases, or help to avoid a surgical incision in a gummatous lesion. Aside from the purely surgical aspect it is important for diagnostic, humanitarian and economic reasons to make a diagnosis of syphilis before surgery is undertaken. My study seems to prove that if the clinician will cultivate the suspicion of syphilis as the syphilographer does, if he will employ the Wassermann test routinely, keep in mind the vital damage frequently produced by syphilis, and treat it intelligently before or immediately after operation, the postoperative complications can be reduced to a negligible minimum[1].

CONCLUSIONS

1. Patients with syphilis, who have been treated, can be operated on with impunity.

2. The patient whose infection is of long duration is on the whole a poor surgical risk, but only in proportion to the damage his tissues have sustained. He is no worse a risk than another patient with an equal amount of damage from some other cause.

3. Untreated patients rarely develop postoperative difficulties (7 per cent), but operation on a gumma will increase the damage and reflects on the diagnostic ability of the physician.

4. In a suspected case, conservatism indicates careful treatment before surgery is undertaken, if the lesion is not of an emergent character.

5. The age, sex, and anatomic systems involved seem not to influence the postoperative course.

6. A considerable number of patients with syphilis are evidently operated on regularly without the surgeon being aware of the condition. A routine Wassermann test materially reduces this number.

7. A dose or two of arsphenamin, preparatory to operation, is not necessarily a wise procedure, except as a protective measure for the surgeon.

8. The clinician's suspicious attitude, a routine Wassermann test, and proper treatment in certain cases will reduce to a minimum the operative risk.

9. The older patient presents a general medical problem, and clinical investigation not only of the presenting symptom, but of the patient as a whole is indicated. It is likely that the damage due to syphilis is more extensive than a casual examination would seem to indicate. The cardiovascular and nervous systems are likely to have sustained the brunt of the infection.

[1]Since the material for this paper was collected, it has become a standing rule in the Clinic to make a pre-operative blood Wassermann test on all surgical cases.

BIBLIOGRAPHY

1. DARNALL, W. E. Syphilis as a cause of delayed healing in the noninfected abdominal incision. Med. Rec., 1919, xcvi, 863.
2. GIBBON, J. H. Surgical technique. In Keen's Surgery. Philadelphia: W. B. Saunders & Co., 1911, v, 621.
3. GELLHORN, G. The rôle of syphilis in surgery. South. M. J., 1918, xi, 369–372.
4. STOKES, J. H. The clinical approach to syphilis, with suggestions for its revival and development. Arch. Dermat. & Syph., 1920, ii, 473–492.
5. STOKES, J. H., and BREHMER, Helen E. Syphilis in railroad employees; a clinical study of an occupational group. J. Indust. & Hyg., 1920, i, 419–427.

PERFORATION OF SILENT ULCER OF DUODENUM FROM EXTERNAL TRAUMA

By H. W. POWERS, M.D., F.A.C.S., Conrad, Montana

UNDER the title of perforation of silent ulcer of the duodenum from external trauma, I wish to report 4 cases occurring in my practice and that of my colleague, Dr. W. F. Paterson.

On reviewing the literature at my disposal I can find but little reference to trauma as an etiological factor causing perforation of ulcers of the duodenum.

One of the first articles on this subject was brought forward in April, 1900, by Robert F. Weir of New York, but it was not until 1902, that that master surgeon, the late John B. Murphy of Chicago, writing on perforating ulcers of the duodenum, referred to the rarity of duodenal ulcers and the meagerness of the literature. He added that Dr. Robert F. Weir in 1900 gave us the masterpiece on duodenal perforations. In a review of the literature we find that a still rarer condition is the perforation of a symptomless duodenal ulcer by external trauma. We have found only a limited number of such cases reported. Moynihan of London, in his extensive book on duodenal ulcers, says, when writing of perforation of these ulcers: "The immediate cause of the perforation is not easy to discover. In not a few cases some definite disturbance is held responsible, such as, a blow on the side, overreaching, a sudden twist, or coughing or sneezing." In one of his own cases, the patient was crushed by a heavy barrel which fell across the abdomen. In most of the cases, however, no definite causative factor can be ascertained.

Robert F. Weir, in the article referred to by Murphy, brought the literature up to date, and reported all cases operated on for acute perforation of duodenal ulcers previous to that time. He gave the history of 51 cases, and among this number only 4 were mentioned which were due to trauma. In one case, a man in good health, while lifting a barrel from a dray, felt a sudden pain across the abdomen like a knife, and vomiting immediately began and continued. Operation in 62 hours revealed perforation of a duodenal ulcer; death occurred in 3 hours. Another young man in perfect health who had never had any gastric symptoms, was stricken while trying to open a sack. Incessant vomiting with death followed within 30 hours. Autopsy showed duodenal perforation and general peritonitis. In the third case the condition was due to the patient having lifted a heavy weight, causing something to snap in the abdomen; this was also a fatal case. In the fourth case, the man gave a history of dyspepsia and the fatal attack occurred while he was stooping to draw off his shoes.

Murphy, in his article of September 27, 1902, cites a case of a French observer, in which the violent effort of a man to lift a heavy log caused an ulcer of the duodenum to perforate. A similar case is reported by C. H. Peck of New York, in which a perforation of a duodenal ulcer was due to the patient's lifting a heavy tank of gasoline.

A. H. Noehren (5) says: "External trauma is rarely an etiologic factor." He further states that the most common immediate cause of actual perforation is overloading of the stomach with undue stretching, and next to this is trauma that causes a pull on the weakened wall of the intestines.

Thus perforation occurs frequently after a hearty meal, or while the patient is engaged in strenuous work or exercise.

That external trauma is a factor in a small percentage of cases, is beyond question as is shown in Cases 1 and 4. In Case 1 no food had been taken but liquids for 2 days, and in Case 4, no food had been taken for 8 hours prior to perforation. Some cases of perforated duodenal ulcer may give no previous history of ulcer or of digestive disorder. Willinski[1], in his most admirable résumé for the year, does not mention external trauma as a factor producing perforation of duodenal ulcer.

[1] Prog. méd., 1922.

It is not in the scope of this short paper to discuss the various causes of ulcers of the duodenum or their operative treatment. Suffice it to say that we close the perforation with a through-and-through chromic catgut No. 1, with a superimposed linen suture, and in Cases 1 and 3 a tab of omentum was sutured over the line of suture and a suprapubic stab wound added. I did not do gastro-enterostomy, as I saw no indication for the operation. So far as the general condition of the patient was concerned the operation could have been easily performed. We considered the ulcers acute, because (1) there was no history of previous stomach trouble and (2) the operative findings showed no induration or thickening at the site of perforation.

Some surgeons advise gastro-enterostomy after closure of the perforation in such cases as a routine if the condition of the patient permits, or at a later date, if stomach symptoms develop. My experience in acute perforations is too limited to offer an opinion on this point. The results to date on cases reported have been quite satisfactory. However, if the patient's condition permitted, I would in any case do gastro-enterostomy if the indications for the operation were present.

Since writing the above article, I have a verbal report of a fifth case occurring in the practice of my friend, Dr. J. F. Murphy of Fort Benton, Montana. A young man, a baseball player, who had never been ill in his life, was struck over the right hypochondrium with a baseball, followed by severe pain and vomiting. He was not seen by Dr. Murphy until 36 hours after the injury. General peritonitis was present. Operation showed perforation on the anterior wall of the duodenum; there was no induration or thickening. Death occurred 24 hours later.

CASE 1. A male, farmer, age 29, married, had father and mother living and three brothers living and well.

Personal history. He had never been ill in his life before. He said he thought he had had measles when he was about 3 years old. He never had had any symptoms suggestive of stomach trouble. The bowels were quite regular.

Present trouble. In the evening, after an early dinner, he went to a neighboring farm to get a mule. He sat in the back seat of an auto to lead the mule, but stepped on the running board of the car to get better control when the mule became frightened by a dog. He was jerked violently forward on his abdomen but got up at once, and as he did so, was stricken with a violent pain in the abdomen and had to be assisted into the house. The pain was so intense, using the patient's expression, "It felt as though a spike was being driven through." He vomited a few particles of his early dinner. I saw him at 11 p.m., about one and one half hours after the onset. He was lying on a couch fully dressed, his face the picture of much suffering, his skin cold and moist; pulse 92, temperature 98.2, respiration 24, short, grunty, and costal in character.

Examination of head, neck, and chest was negative with the exception of some gingivitis of his upper and lower incisors. The gingivitis may have been due to his rather excessive pipe smoking. The abdomen was concave and very rigid. The least movement of his body caused much pain. His position was as if he were held in a vise. After morphine had been given to relieve the pain he was removed to the hospital under a diagnosis of an acute abdomen and probable perforation of a gastric or duodenal ulcer. Immediate operation was advised.

Operation was performed at 2 a.m. under ether anæsthesia through an upper right rectus incision. When the abdomen was opened a slight amount of gas escaped. When the gall bladder and right lobe of the liver were lifted upward and to the right with traction on the duodenum downward, a small amount of fluid bubbled forth from a small perforation on the anterior wall. The first portion of the duodenum was surrounded by a small wall of lymph. A purse string suture of No. 1 chromic catgut closed the perforation, then a seroserous suture of linen at right angles to the long axis of the duodenum and a tab of omentum over the suture line completed the operation. All free fluid was carefully mopped up, particular attention being given to the right kidney pouch. A split rubber tube was introduced into the rectal pouch through a suprapubic stab wound. The postoperative course was quite smooth. The patient left the hospital on the eighteenth day feeling fit. He was given instructions regarding diet and alkalies before meals, with instructions to use them for 6 months. He has been heard from regularly since, and as far as his stomach condition is concerned remains quite well.

CASE 2. A male, age 36, a clerk, had had the usual diseases of childhood, but no serious illness since. The father died at age of 63, from an unknown cause; the mother is living and well. For several years past he had drunk moderately of beer and smoked cigarettes. He denied venereal diseases; and had never had any stomach trouble; the bowels were regular.

Present trouble began while out hunting ducks. He and his companions sat down to lunch at about 5 p.m. In a friendly scuffle one of his companions tripped him, falling on him quite heavily. This was

followed by sharp pains in the upper part of the abdomen. He tried to eat some lunch but the pain became very intense. Vomiting and collapse followed, and it was with great difficulty that he was brought by auto a distance of 12 miles to a hospital. I saw him at 8 p.m.

Physical examination. The patient was a young man of frail physique, with face drawn and pinched from suffering; pulse 88; temperature 99.4 degrees; head and neck negative (except several carious teeth). The chest was negative. There was diffuse abdominal tenderness but no localized finding. There was as much tenderness over the lower right half of the abdomen as over the upper. Rectal examination was negative. White blood corpuscles, 11,000; no differential. The urine was negative. A diagnosis was made of perforation of gastric or duodenal ulcer and immediate operation was advised. He was removed to the operating room at once and under ether anæsthesia preceded by ¼ grain morphine and atropine 1/150 grain, an upper right rectus incision was made.

When the abdomen was opened some gas escaped. A small perforation in the anterior wall of the duodenum admitted the point of a closed pair of Murphy hæmostats. There was no induration and the ulcer appeared to be punched out. The ulcer was cauterized with actual cautery and a purse-string suture of No. 1 chromic catgut used; then a seroserous suture of linen was made at a right angle to the long axis of the bowel; a suprapubic drain was inserted and the abdomen closed in layers. Recovery was uninterrupted. The patient left the hospital on the fourteenth day with instructions for ulcer diet and alkalies, and was advised to continue this for 6 months. He remains well at the present time.

CASE 3. A male, age 61, gave a family history of no importance.

Personal history. He has never been ill. He used tobacco and alcohol to excess, and denied venereal disease. He never had any stomach trouble. The patient expressed it: "I could digest nails."

Present trouble. He had been on a "spree" and was in a room with a number of other men when a fight started, and during the fight he was thrown violently across the edge of a card table, striking over the right hypochondriac region. He was partially dazed, and when he came to was suffering intense pain in the abdomen. He was carried to an adjoining room and placed in bed and was given another drink of whiskey, which he promptly vomited. A doctor did not see him until the following day when he was ordered to the hospital. I saw him at 5.45 p.m. at the hospital, 36 hours after the injury.

His face was flushed, pulse 92, temperature 99.8, tongue dry and furred. The teeth were in very poor condition from extensive pyorrhœa. Neck and chest were negative. The abdomen was scaphoid. The upper abdomen was board-like, the lower abdomen not so rigid or tender. There was no distention or vomiting. The patient vomited a number of times during the first 24 hours of his illness, but had taken no fluid by mouth because of the pain and vomiting which it produced. I felt that a great deal of his vomiting was due to his past indulgence in corn whiskey. The white blood cells were 15,000. Urine was negative. A diagnosis was made of an acute abdomen due to trauma, and as the patient said he was better than during the preceding 24 hours, we decided to wait until morning and see if there would be any improvement following the Fowler position and Murphy drip. Next day there was some improvement in pulse, and the temperature was down. We decided to wait 24 hours longer. At the expiration of this time, the pulse and temperature were about the same and operation was decided upon.

An upper right rectus incision was made and showed the gall bladder and adherent omentum. On separating the adhesions, I found the fundus of the gall bladder adherent to a perforation on the anterior wall of the duodenum and it was about the size of a small dried pea. Aside from plastic exudation around the margin of the ulcer there was no induration or thickening. The wound was closed with purse string sutures of linen at right angles to the long axis of bowel and was then covered with a tab of omentum. The abdomen was closed in layers. Recovery was uninterrupted and the patient left the hospital on the thirteenth day against our wishes. He was instructed to use ulcer diet and alkalies, and was advised to have his teeth attended to by a dentist. He has remained well except for a very obstinate constipation.

CASE 4. A male, age 57, entered the hospital December 11, 1923. The family history was negative. Two brothers and sisters were living. He had never been seriously ill. Three years ago he developed bladder trouble and the prostate was removed one year ago in February; he had been feeling well since. He never had any stomach trouble, and was accustomed to hard outdoor work. He was a well driller.

Present trouble. He had just come off a tour and was preparing to retire when he was called by one of his fellow workmen to assist in handling a bit which weighed many hundred pounds. He lifted hard, and in doing so his foot slipped and he fell partially across the end of the bit and the upper right side of his abdomen struck the edge of the door jam of the drilling house. At that time he did not complain of any pain of consequence. He walked but a few rods to the bunk house and sat down on the edge of the bed to remove his shoes when he was stricken with an intense pain in the upper abdomen and vomited at once. The pain was so severe for the time being he could not be straightened on the bed. This was about 9.30 in the evening. A doctor was called at 3 a.m., and morphine administered. At 4 p.m. his condition was much worse. He was sent by car 55 miles to a hospital, arriving at 11 p.m. in a very critical condition. He was semi-conscious, pulseless, and cold. Saline transfusion and stimula-

tion were all futile, and the patient died early the next day.

Partial autopsy was permitted in this case. There was a perforation of the anterior wall of the duodenum somewhat nearer the superior border about the size of a dried pea, with the mucous membrane everting through the perforation. There was no thickening or induration about the perforation suggestive of an old ulcer. It had the appearance of the ulcer in Case 3 which I am reporting. It was punched out.

I am at a loss in this case to determine the source of infection if focal in origin, as the tonsillar tissue that he had did not appear to be infected and he was wearing an upper and lower plate. He denied venereal infection.

BIBLIOGRAPHY

1. Aaron, Charles D. Diseases of the Digestive Organs. Philadelphia: Lea & Febiger, 1921, p. 708.
2. Farr, E. H. Ann. Surg., 1922, August.
3. Moynihan, B. G. A. Duodenal Ulcer. Philadelphia: W. B. Saunders Co., 1910.
4. Murphy and Neff, J. M. Perforating ulcers of the duodenum. New York M. J., September 20, 1902.
5. Noehren, Alfred H. Acute perforation of gastric and duodenal ulcer (with 18 references). New York M. J., 1922, June 7, p. 674–677.
6. Peck, Charles H. Perforated gastric and duodenal ulcer; a report of eight cases. Med. Rec., 1907, December 7, 930–934.
7. Weir, Robert F. Perforating ulcer of the duodenum. (a report of 51 cases). Boston M. & S. J., 1900, May 3, p. 453–463.

THE TREATMENT OF ABORTION[1]

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From the Surgical Clinic of Ancon Hospital

THE question of early operation or expectant conservatism is still debated. Hillis (3) of Chicago, after an exhaustive review of 1,000 cases of abortion concludes that:

(a) "Febrile patients who have a 5 day afebrile period have a greater tendency to continue a normal temperature after curettage than those who are operated upon before the end of this period. (b) Afebrile patients with a 5 day observation period have a greater tendency to remain with a normal temperature than do those who are curetted before the end of this period."

It has been the policy at Ancon Hospital to empty the uterus by operative procedure in all cases of abortion when membranes and placental tissue remain in the uterus. To compare the results with those obtained by more conservative methods of other clinics a study was made of all abortion cases admitted to the hospital between the years 1904 and 1923 inclusive.

During this time 1,164 cases have been treated. Of this number, 718 were white, 444 were black, and 2 were yellow.

The age of patients and the period of gestation at which interruption occurred is shown in Tables I and II.

TABLE I. AGE OF PATIENTS—TEN YEAR PERIODS

	Case
10 to 19	73
20 to 29	692
30 to 39	349
40 to 49	34
Not stated	16
Total	1164

TABLE II. PERIOD OF GESTATION

Month of Pregnancy	Cases
First month	17
Six weeks	84
Second month	257
Third month	235
Fourth month	130
Fifth month	63
Sixth month	65
Seventh month	65
Eighth month	25
Undetermined	223
Total	1164

The various etiological factors are arranged under Table III.

Traumatisms, as falls, blows, jerks, missteps, etc., are frequently thought by the negro women to cause abortion. Undoubtedly this is largely coincident as few escape such minor injuries with their hard work. Minor operations of the external genitals, anus, and perineum are shown to be a causative factor in some cases.

[1]Read before the Canal Zone Medical Society, March 27, 1924.

Malaria is known to be a distinct cause of abortion in the tropics and Dr. H. C. Clark (1), pathologist for the United Fruit Company, is of the opinion that during the first trimester, before the placental sinuses have formed, the abortion is due to the high fever and toxins as in other acute diseases. Toward the latter part of the second trimester and during the entire third trimester, the plugging of the placental sinuses by parasites becomes a decided factor in the interruption of the pregnancy.

Criminal and self-induced abortions are relatively few and it is believed that the figures given do not represent all that should be included in this group. The hard rubber catheter is the favorite means for self-induction although hairpins and sharp sticks are sometimes substituted. Among drugs, quinine on account of the common tropical knowledge of its oxytocic action, is most frequently used.

TABLE III. ETIOLOGY OF ABORTIONS

		Cases
Spontaneous.	Cause undetermined	807
Traumatism.	Accidental	81
	Following genital operations	8
Infectious diseases and acute infections		18
Malaria		42
Syphilis		26
Toxæmias of pregnancy		21
Uterine or ovum pathology		69
Criminal or self-induced		33
Therapeutic		35
Miscellaneous		24
Total		1,164

The most common causes for seeking hospital treatment in the order of their frequency are as follows:

	Cases
Pain	642
Hæmorrhage, associated with other causes	450
Hæmorrhage, alone	266
Fever	154
Chills	112
Vomiting	91
Foul vaginal discharge	56
Retained placenta	50
Toxæmias of pregnancy	40
Loss of amniotic fluid	27
Cessation of fetal movements	9

The number of days elapsing from onset of symptoms to hospital admission is given in Table IV. This shows that in numerous instances patients have received treatment from dispensaries and private physicians for some time previous to hospital admission.

TABLE IV. DAYS ELAPSING BETWEEN ONSET OF SYMPTOMS AND ADMISSION TO HOSPITAL

	Cases
Admitted same day	122
Admitted after second to seventh day	643
Admitted after eighth to fourteenth day	138
Admitted after fifteenth to thirtieth day	85
Admitted after thirty-first day or later	115
Length of time undetermined	61
Total	1164

The temperature on admission is shown in Table V. Temperature under 100 degrees F. is considered afebrile and 785 cases (67.3 per cent) are included in this group. The febrile cases, 100 degrees F. and over, number 376 or 32.4 per cent. The admission temperature was not recorded in three instances.

Hæmorrhage on admission is rated on a scale of four; one + signifies hæmorrhage up to that comparable with the menstrual flow in quantity; two + denotes moderate bleeding not severe enough to cause symptoms; three + means excessive hæmorrhage with symptoms but not sufficiently severe to threaten life at the time of observation. Four + includes those cases with varying degrees of exsanguination and its signs and symptoms. Hæmorrhage on admission falling in groups three or four calls for immediate active measures to preserve life. The percentage of such cases was 4.2. The number of cases in their respective groups and the percentage of occurrence is shown in Table VI.

TABLE V. TEMPERATURE ON ADMISSION

	Cases
96 degrees	4
97 degrees	18
98 degrees	313
99 degrees	450
100 degrees	209
101 degrees	67
102 degrees	57
103 degrees	22
104 degrees	15
105 degrees	6

TABLE VI. HÆMORRHAGE ON ADMISSION

	Cases	Per cent
None	551	47.3
+	469	48.4
++	95	
+++	30	4.2
++++	19	

All cases admitted to the hospital without positive evidence of the fetus having been expelled, who on examination were found not to

have reached an inevitable stage, were treated as threatened abortion cases with absolute rest in bed and opiates when necessary. This treatment is continued until the symptoms subside or the case becomes one of inevitable abortion, unless hæmorrhage compels active measures. One hundred and thirty-five cases were discharged from the hospital with the diagnosis of threatened abortion after the symptoms had entirely subsided. It has been possible to follow up 66 by re-admissions; in 23 (34.8 per cent) abortion occurred subsequently; and in 43 (65.2 per cent) the pregnancy proceeded to full term. Study of these cases shows that no single symptom or group of symptoms can be accurately relied on as prognostic evidence that the pregnancy will not go to term.

The diagnosis of incomplete abortion is made when the patient states she has seen the fetus without membranes or placenta and physical findings are such as to corroborate this statement; when the patient brings the fetus with broken cord to the hospital; when the fetus is expelled alone after admission to the hospital; and when continued hæmorrhage with dilated cervix and boggy uterus indicate that the fetus has been passed and membrane and placenta remain in the uterus. Cases with three or four plus hæmorrhage are immediately packed or the uterus emptied instrumentally. We have found the method of packing the cervix with gauze and the vagina with moist absorbent cotton as recommended by DeLee (2) to be very efficient in controlling hæmorrhage and when the packing is removed at the end of 24 hours the fetus and secundines usually come away with the packing or may be removed from the cervix with ovum forceps without anæsthesia. Those cases with moderate bleeding are given ergot and pituitrin and operation delayed a day or more. A certain per cent of these cases will complete the abortion without operative measures. Operative methods used to empty the uterus are gauze on the finger or forceps, ovum forceps, and a dull or spoon curette, with or without preliminary instrumental dilatation as may be necessary. A sharp curette is never used in a recent abortion and the utmost caution and gentleness is employed inside the uterus. We have no record of a uterus being perforated instrumentally in this clinic while treatment for abortion was being carried out. When emptied, the uterus is packed with iodoform gauze and small bits of remaining membrane come away with the packing on removal at the end of 24 hours.

Table VII shows the number of days elapsing between admission to hospital and operation, and the number of pre-operative hæmorrhages and febrile days in the hospital.

Uncomplicated complete abortion rarely requires more than a few days' rest in bed with administration of ergot or pituitrin. An occasional case requires curettement but this usually means the uterus is not entirely empty or retrodisplacement with clots and subinvolution are present.

Cases with high intermittent fever and chills, rapid pulse, tender uterus and lower abdomen, with or without foul vaginal discharge are recognized as septic abortions. Seventy-nine patients were thus classified, 65 having incomplete and 14 complete abortion. The mortality in this series of cases was 12 (15.2 per cent).

Fifteen cases admitted either criminal or self-induced abortion. Sixty-four of the 79 cases were operated upon and all deaths but one were in cases operated upon. Three deaths were complicated by four plus hæmorrhage. Nine cases received antistreptococcus serum intravenously in total amounts varying from 20 to 1400 cubic centimeters, with 2 deaths.

To estimate the value of our treatment we have separated the cases into groups: the febrile operative, the afebrile operative, and all non-operative cases. The average postoperative febrile days, the number and percentage of patients having no postoperative febrile days, the morbidity, and the average number of hospital days are determined in the respective groups. The morbidity percentage is computed from all operative cases showing more than 3 postoperative febrile days and all non-operative cases showing more than 3 febrile days in the hospital. For findings, see Tables VIII and IX.

Therapeutic abortion was performed in 35 cases, 23 times for toxæmia of pregnancy and once each for peritoneal adhesions and con-

TABLE VII. CASES OPERATED UPON[1]

Number of days	None	1	2	3	4	5	6 to 10	11 to 15	16 to 20	21 to 30	30 to 40	Total
Between admission and operation	71	357	98	58	33	29	34	16	6	4	4	710
Hæmorrhage before operation in hospital	257	205	98	48	32	21	40	6	1	1	1	710
Pre-operative febrile course in hospital	312	229	82	36	18	7	18	5	1	1	1	710

[1] This includes 35 therapeutic abortions, 1 missed abortion, and 6 cases operated upon for conditions other than abortion.

TABLE VIII. FEBRILE CASES OPERATED UPON—TOTAL 270

Pre-operative afebrile days in hospital	0	1	2	3	4	5	6
Total cases	166	44	21	13	9	5	18
Total postoperative febrile days	460	127	31	8	15	7	24
Average postoperative febrile days	2.7	2.9	1.5	0.6	1.7	1.4	1.3
Total with no postoperative febrile days	65	21	10	8	4	4	10
Percentage of postoperative febrile days	38	47.7	47.6	61.5	44.4	80	55.5
Total more than 3 postoperative febrile days	23	6	3	0	2	1	3
Per cent morbidity	13.8	13.6	14.3	0	22.2	20	16.6
Total hospital days	1710	509	244	135	146	100	404
Average hospital days	10.3	11.5	11.6	10	16.2	20	22.4

TABLE XI. ABORTIONS DUE TO DISEASE CAUSING DEATH

	Total	Toxæmia of pregnancy	Lobar pneumonia	Septic endocarditis	General tuberculosis	Typhoid	Pyonephrosis	Amœbic abscess of liver	Malaria	Pyosalpinx and fibroid	Total	Per cent
Operated upon Incomplete	656	1		1	1	1	1	1			7	1.04
Operated upon Complete	15									1		
Not operated upon Incomplete	20	1									3	.93
Not operated upon Complete	302		1						1			
Threatened	135											
Therapeutic	35	5									5	14.3
Missed	1											
Total	1,164	7	1	1	1	1	1	1	1	1	15	1.28

tracted pelvis. The following procedures have been used to terminate the pregnancy:

Dilatation and curettement	25
Catheter in uterus	5
Hysterotomy	4
Hysterectomy	1

There were 5 deaths in the series, all in cases of toxæmia. Cases of toxæmia requiring therapeutic abortion have become much less frequent, since the introduction of the intravenous use of corpus luteum, with solution of glucose and soda bicarbonate rectally by Murphy drip.

The final results show that 1,121 patients were discharged well, 14 discharged against advice as improved, and 3 discharged against

TABLE IX. AFEBRILE OPERATIVE AND NON-OPERATIVE CASES

	Afebrile cases operated upon	Total cases operated upon	Cases not operated upon
Total cases	398	668	322
Total postoperative febrile days	243	915	455
Average postoperative febrile days	0.6	1.37	1.41
Total with no postoperative febrile days	277	399	146
Per cent with no postoperative febrile days	69	59	45.3
With more than 3 postoperative febrile days[1]	12	50	30
Per cent morbidity	3	7.4	9.6
Total hospital days	3820	7068	3576
Average hospital days	9.6	10.6	11.1

[1] In non-operative cases more than 3 febrile days in hospital.

advice as not improved. There were 26 deaths, or a total mortality of 2.23 per cent.

The causes of death due directly to abortion, and those due to the various diseases causing the complicating abortion are shown in Tables X and XI.

TABLE X. CAUSES OF DEATH DUE TO ABORTION

	Total	General peritonitis	Streptococcus septicæmia	Staphylococcus septicæmia	Pyæmia	Total	Per cent
Incomplete Operated upon	656	2	5	1	1	9	1.34
Complete Operated upon	15						
Incomplete Not operated upon	20	1				1	.31
Complete Not operated upon	302						
Threatened	135						
Therapeutic	35		1			1	2.88
Missed	1						
Total	1,164	3	6	1	1	11	.94

CONCLUSIONS

1. Abortion of any type is a serious condition and operative treatment should never be considered lightly. Unless proper hospital facilities and operative technique are available the condition had better be treated expectantly.

2. Hæmorrhage sufficiently severe to call for immediate active treatment is seen in approximately 5 per cent of all cases. Attention is called to those cases with little or no external bleeding that pass large clots at intervals which, if passed unobserved, will soon bring the patient to a dangerous condition from hæmorrhage or lowered resistance to infection.

3. The records of this hospital show that febrile abortion cases operated upon promptly have slightly higher average number of postoperative febrile days, a lower per cent morbidity, and fewer average hospital days than those operated upon a number of days after the temperature has remained normal. The average febrile days, morbidity percentage, and average hospital days of operative cases are lower than in the non-operative. We believe that in the ordinary incomplete abortion the sooner the uterus is emptied the shorter will be the convalescence. Many cases will be discharged from the hospital at the end of a 5-day period.

4. The treatment of septic abortion requires mature judgment. Those cases where infection has extended beyond the uterus, and without evidence of retained necrotic placenta or membranes should be treated expectantly. However, in our opinion when such tissue remains in the uterus it is just as essential to remove it as a sloughing appendix in the abdomen, provided the removal can be accomplished without spreading the infection. Both are sources of infection so long as they remain *in situ*.

5. Surgical treatment is difficult to standardize and no one method will apply equally to all cases.

REFERENCES

1. Clark, H. C. Personal communication.
2. DeLee, J. B. Principles and practice of obstetrics. Philadelphia: W. B. Saunders, 1913, 426.
3. Hillis, David S. Experience with one thousand cases of abortion. Surg., Gynec. & Obst., 1924, xxxviii, 83.

METAMORPHOSED FAT DEPOSITS IN SUBDELTOID BURSITIS

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Orthopedic Surgeon to Mount Sinai and St. John's Hospitals

THE literature of subdeltoid bursitis contains many references to the early and sudden appearance of "calcium" deposits in the walls of the bursa or in the supraspinatus tendon (which is inserted into the greater tuberosity of the humerus at the base of the bursa) and to its equally sudden disappearance after the use of many forms of non-operative treatment—chiefly the various physiotherapeutic measures.

Brickner speaks of the appearance of these "calcium" deposits as seen on the X-ray, 48 hours after an injury in which the initial roentgenograms (taken immediately after the accident) were negative for such deposits. On the other hand Ervine notes the disappearance of such deposits within a few days after beginning treatment with rest and hot packs.

Recently Harris, chief physiotherapist to Mount Sinai Hospital, New York City, reported the complete disappearance of such deposits in twelve cases treated by diathermy.

The evidence that such deposits are calcium or lime salts rests of course upon the interpretation of the roentgenographic shadows. As will be noted in the roentgenograms submitted in this sketch, above the shadow of the humerus (which is beyond controversy bone and therefore calcium) there is in each case a small irregular shadow of a deposit in the supraspinatus tendon, which is at least equal in density to the shadow of the acromion process, and on this account it seems quite probable that the substance casting such a dense shadow must therefore be bone or calcium (Fig. 1). This has always appeared logical to me, and I would undoubtedly have continued to hold this opinion were it not for a recent operative experience which has disproved this theory in at least three cases which are now to be reported.

The sudden appearance and disappearance of such shadows in certain cases, already cited, is not in accord with the usual history of undoubted calcium deposits in the capsule of other joints, in myositis ossificans, periosteitis, after trauma to the shafts of long bones, etc.

In the three cases of subdeltoid bursitis of which roentgenograms before and after operation are shown in Figures 3, 4, 5, 6, 7 and 8, the patients all had the usual symptoms of subdeltoid bursitis, freedom of the sawing

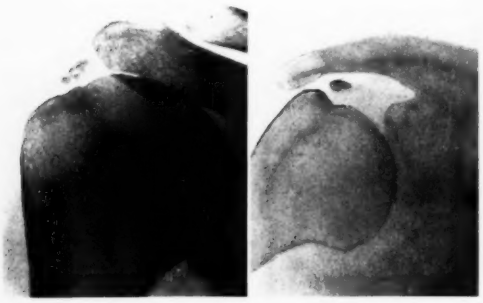

Fig. 1 (left). A typical "calcium" deposit in the supraspinatus tendon.

Fig. 2. Deposit receding beneath acromion in the act of abducting the shoulder.

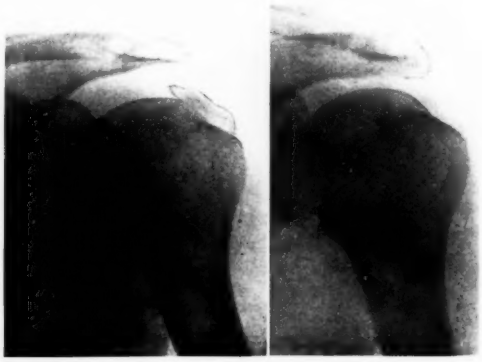

Fig. 3 (left). Case 1. Deposit in supraspinatus tendon before operation.

Fig. 4. Case 1. Disappearance of shadow 4 days after removal of metamorphosed fat tumor.

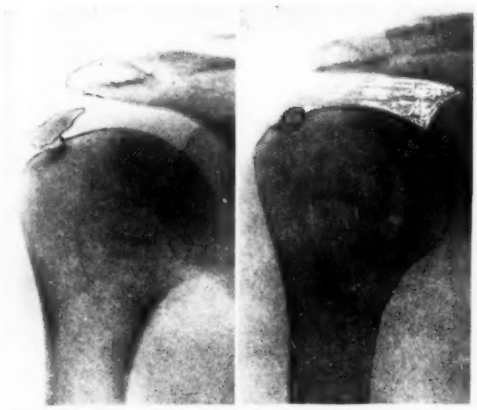

Fig. 5 (left). Case 2. "Calcium" deposit before operation.

Fig. 6. Case 2. Deposit left after removing a metamorphosed fat tumor.

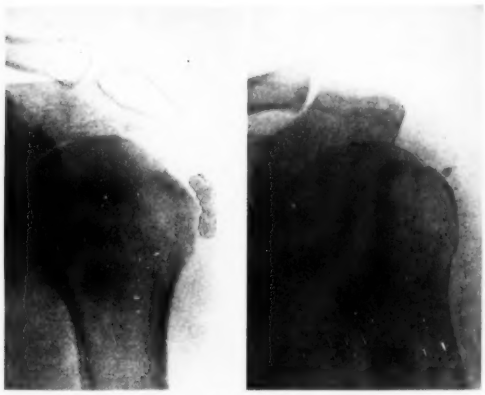

Fig. 7 (left). Case 4. Deposits in wall of bursa 4 days after acute onset of a bursitis following infection.

Fig. 8. Case 4. After 2 weeks of rest, abduction, hot packs, and massage. Deposits gone.

motions in the shoulder joints, inability to abduct and rotate the arm (both actively and passively), tenderness, pain radiating down arm into the elbow and even forearm, inability to place the hand back of head or buttock, etc. In each case the symptoms became so severe that operative interference was indicated, after the failure to obtain relief from physiotherapy. For a period of about 2 weeks Case 3 obtained relief from all symptoms, for a couple of hours at least, after the use of diathermy at 700 milliamperes for 30 minutes, only to find the shoulder more stiffened and painful than ever, at the end of the third hour. A sudden onset of acute pain drove him to the operation table at the end of his second week's treatment. Figure 3 is the roentgenogram taken at this time.

In all three cases the operation showed a small, oblong, encapsulated, soft but firm, nonfluctuating tumor, in or upon the supraspinatus tendon at its insertion in the greater tuberosity. The contents of the tumor were granular, non-crystalline, non-oily, nonfluid, brownish gray in color and absolutely *not* hard or bony when scraped with a knife blade. Nowhere was a bony or calcium deposit to be found. That we actually removed the shadow-casting deposit in Case 1 (the subject of plates 3 and 4) can be verified in plate 4 taken a few days after the operation.

Case 4 is that of a young man who developed an acute bursitis of the right shoulder after an attack of tonsillitis. The shoulder had never troubled him before. On the fourth day after the onset of the bursitis he was admitted to the Mount Sinai Hospital where the roentgenogram (Fig. 7) showed a dense deposit in the wall of the bursa. After a fortnight of rest and physiotherapy the man was well and the roentgenogram (Fig. 8) shows the disappearance of the shadow.

Fig. 9. Shadow cast by a hæmatoma of elbow 3 weeks after fracture of head of radius. No bony tumor found at operation except moderate callus at site of fracture.

The laboratory reports in all three operative cases called the substance amorphous fat. It dissolved completely in ether and stained with osmic acid and Sudan III, while the chemical tests for calcium were all negative.

The fact that some of such shadow-casting tumors are of a fatty nature will, I believe readily explain the phenomena of their sudden appearance and disappearance, although no explanation can be offered as to why a previously radiolucent substance or tumor, such as fat, takes on the property of radiopacity. In this light it is interesting to note that certain hæmatomata especially those about the elbow and in the thigh have been known to cast shadows comparable with, if not equal to, bone shadows, although no calcium was present in the mass (Fig. 9). In these cases too, the contents of the hæmatoma are granular, grumy, and of coffee ground like consistency.

VISIBLE CHANGES IN THE LIVER IN CHRONIC CHOLECYSTITIS

By RALPH EMERSON WEIBLE, M.D., F.A.C.S., Fargo, North Dakota

THAT hepatitis is always present when the gall bladder is the seat of an inflammation is now an accepted fact. Therefore, would it not be probable that hepatitis, if prolonged, would result in changes in the liver that could be seen?

In an attempt to answer this question I have for the past 5 years examined the liver whenever it was exposed at operation, and many times changes were found in the region of the gall bladder. A report of my observations was presented in a paper to the North Dakota State Medical Association in June, 1923, and this paper was published the following December in the *Journal-Lancet*. While several papers, giving some of the phenomena associated with chronic cholecystitis, have appeared since then, my paper was the first in the literature to describe the phenomena.

These changes are of two types: There appear first, dull gray patches on the liver near the gall bladder, often of considerable size; second, milky white lines of varying length, breadth, prominence, and pattern. These lines may be few in number, perhaps not more than one-half inch in length, flush with the liver surfaces; there may be a longer irregular line with a few branches, not unlike the stalk and branches of a shrub; the lines may present a heavy, depressed, scar-like appearance branching and extending out in different directions; they may be interlacing, reticulated in arrangement, not unlike the pattern of a fishnet. If few in number they are situated nearby and on either or both sides of the gall bladder. If more numerous, they are found in an area of several inches about the gall bladder. The convex surface of the liver directly opposite the gall bladder will also present these changes, usually in conjunction with inferior surface markings and distributed within approximately the same area. Frequently, the inferior surface will exhibit scars or branching lines, while the superior has a patch of dull gray the diameter of a billiard ball or larger. And finally, the dull gray patches and lines may be mixed together. In some patients with extremely long standing inflammation of the gall bladder there are deep-set surface markings, reticulated in appearance, distributed over the entire visible surface of the liver. This phenomenon was seen in a patient who gave a history of cholecystitis of over 40 years' duration, in whom a moderate cirrhosis of the liver was found.

Now what are these liver markings?

Cholecystitis is essentially a disease of the deeper layers of the gall bladder where the lymphatic vessels are numerous. The lymph-vessels carry the inflammation to the liver, where changes can occur, both in the interlobular tissues and on the surface. If an injection of an aqueous solution of Prussian blue is made into the wall of the gall bladder of a living dog, according to the method described by Sudler, the lymph vessels of the

gall bladder will first stand out; then almost imperceptibly a very narrow area of fine, reticulated pattern appears close to the gall bladder on the liver, and as the injection is slowly continued, some of the larger lymphatic vessels with their smaller branches will appear, extending out onto the liver surface. These larger lymphatic vessels are identical in pattern with those branching lines often seen at operations. When present in the human liver, it means that the lymphatic inflammation has been followed by the deposition of fibrous tissue and in the instance of wide, depressed, scar-like markings, a larger amount of fibrous tissue has been formed followed by contraction. If considerable connective tissue forms between the lobules, secondary contraction produces the picture of cirrhosis. The dull gray patches are the result of a perihepatitis.

In 44 cases a section of liver tissue was removed at operation for study, and in every instance in which there were visible liver changes, hepatitis and perihepatitis were found. As the gall bladder also proved the existence of a chronic inflammation, and as the liver markings were always most numerous close to the gall bladder, it is perfectly safe to assume that only chronic cholecystitis could cause them.

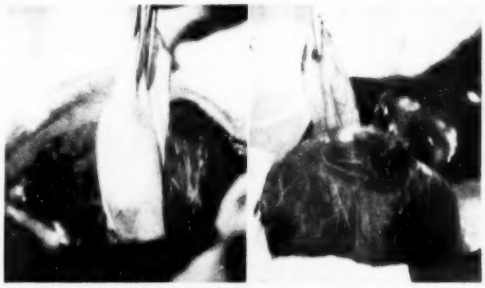

Fig. 1 (left). Mrs. S. H. "Scars" and "lines."
Fig. 2. Mrs. H. S. Superior surface of liver. Large gray "patch" and fine "lines."

While this paper is based principally on the review of 95 cases of chronic cholecystitis that have come to operation, the records of the earlier cases gave a description of the appearance of the liver only in the more marked instances. The last 46 cases, however, show that visible liver changes were present 27 times and absent 19 times, or were present in nearly 60 per cent of the cases.

It is but a short time ago that only severe biliary infection or agonizing attacks of gall-

Fig. 3. Inferior surface of liver showing "scars" and "lines." The white spots are high lights.

Fig. 4. Superior surface of same liver as shown in Figure 3, showing large gray patch. The white areas at lower right are high lights.

stone colic were deemed worthy of operative intervention. A big advance was made when the frequency of cholecystitis as the cause of gastro-intestinal symptoms was recognized. Now we are just beginning to realize that a "silent gall bladder" is one of the most common, next to aural infection, of the focal infections. In the last two instances, the appearance of the gall bladder is frequently normal and the *raison d'être* for the cholecystectomy is based on enlarged cystic duct glands, the swollen pancreas, adhesions, or maybe only the history. Any, most, or all of these indicators may be absent, and yet a cholecystitis be the cause of real illness.

I have recently had a patient, a woman of 40 who while in a state of apparent good health, was suddenly attacked by violent pain in the back above the right hip, which radiated over to the right lower quadrant of the abdomen and extended down the leg to the toes. Any movement, if only that of the toes, would bring on a paroxysm of pain. Her tonsils and teeth had been removed, her nasal passages were healthy, X-ray examination of the gastro-intestinal tract showed no abnormality, and the pelvis was normal. Examination of the blood and urine gave no indication of the cause of her suffering. This posterior sensory root infection suggested a focal cause; but a constant tender point in the right lower quadrant not associated with the ileocæcal viscera, as shown by the X-ray examination, suggested an abdominal source.

The patient demanded relief and an exploration of the gall bladder was offered as the only method that might lead to cure since a thorough examination of all other possible causes had revealed no lesion. She accepted. At operation, the gall bladder and ducts were normal in appearance, but two or three short gray lines were present on the liver near the gall bladder. The gall bladder was removed. Microscopic examination showed large masses of round cell infiltration in the deeper layers and the patient had no more pain.

In contradistinction to changes seen on the liver from any other cause, those which result from chronic cholecystitis are always most pronounced in the gall-bladder region of the surface of the liver "involved," and diminish in number and intensity with the increase of the distance away from the gall bladder. I wish to emphasize their importance in intra-abdominal diagnosis. In the absence of all other signs of inflammation of the gall bladder, these visible changes in the liver, no matter how slight they may be, can be relied upon for the diagnosis of chronic cholecystitis and are as important an indication for the removal of the gall bladder as any of the pathological changes upon which we are accustomed to depend.

THE TREATMENT OF INFECTIONS—GENERAL, LOCAL, AND URINARY WITH THE INTRAVENOUS INJECTION OF MERCUROCHROME[1]

By HUGH H. YOUNG, M.D., F.A.C.S., Baltimore

THE value of mercurochrome, which was brought out only 5 years ago,[2] as a general germicide in many branches of medicine has been attested by numerous papers—now aggregating a large literature. I wish tonight to bring before you a study of the cases in which mercurochrome has been used intravenously which I have been able to collect from our clinic and from personal reports which I have obtained from the medical profession and a few published cases.

Since reporting our first few cases before the New York Medical Society at Buffalo on October 16, 1923, the number of cases in which mercurochrome has been used intravenously has increased with great rapidity and I am now able to present with the assistance of J. H. Hill and W. W. Scott 255 cases, in most of which careful laboratory studies have been made.

1. In analyzing these 255 cases we find many septicæmias in which the case was practically hopeless, a fatal outcome being almost certain until an intravenous therapy with mercurochrome was begun. These have been classified as cured. Other severe local infections are also classed as "cured," when they disappeared promptly after the use of the drug.

2. In the second column are cases in which marked improvement followed the use of the drug intravenously and the patient got well, but we cannot say with certainty that they might not have recovered without mercurochrome, e.g., certain cases of pneumonia.

3. In the third column we have placed cases in which the mercurochrome injections were followed by sterilization of the blood or cure of the septicæmia but complications arose later (such as empyema) from which the patient died, or the local condition relapsed.

4. In the last column are those in which the treatment utterly failed. In many of these the treatment was given very late; in others larger doses or repeated injections might have changed the story.

These 255 cases, classified as to result as above described, are shown in Table I.

Although the table, if carefully studied, makes a very remarkable showing for intravenous mercurochrome in the treatment of infections, both general and local, it is only by the recital of some of the individual cases that the startling results which are often obtained can be pictured. I will, therefore, select a few cases from each category, and also detail some of the failures.

Some of these cases have already been published, and the reference will be given. In many cases I am indebted to the physicians, whose names I give, for the privilege of presenting these personal reports.

Case 1. General septicæmia due to colon bacillus; patient very ill; condition cleared up by intravenous injection of 34 cubic centimeters of 1 per cent mercurochrome.

H. A. D.,[3] male, age 40, was admitted to the hospital December 30, 1922, with pain in kidney of three weeks' duration. Urinalysis showed pus, and bacillus coli communior on culture. Ureter catheterization returned pus from both kidneys. On the following day pain in the right kidney became aggravated, and the patient, very toxic, was admitted to Johns Hopkins Hospital, with temperature of 103.4 degrees F., pulse 124, and muscle spasm and tenderness in region of right kidney. A diagnosis was made of right pyelitis. On the following day the condition became much worse; the patient was irrational; and there were purpuric eruptions on the neck, chest, abdomen and legs. Blood cultures showed a heavy growth of colon bacilli. The patient was seen in consultation with the medical department. A diagnosis of general septicæmia was confirmed and the prognosis was apparently hopeless.

The patient was then given 34 cubic centimeters of a 1 per cent solution of mercurochrome in the arm vein. The temperature rose to 104 degrees F. at midnight, but in six hours had dropped to 97 degrees. The patient became rational in a few hours, and on the following morning his condition was marvelously transformed; the temperature was normal, and he said he felt quite well. A culture

[2] Young, H. H., White, E. C., and Swartz, E. O. J. Am. M. Ass., 1919 xxiii, 1483.

[3] Young, H. H., and Hill, J. H. J. Am. M. Ass., 1924, lxxxii. 669–675.

[1] From paper presented to the Academy of Medicine of Cleveland, Ohio, October 17, 1924.

TABLE I. SUMMARY OF RESULTS. INTRAVENOUS THERAPY WITH MERCUROCHROME OR GENTIAN VIOLET

Type of Case	Total number cases	Recovery or cure due to drug	Marked improvement; cure possibly due to drug	Sterilization or improvement followed by complications	Failure
Group I, Total:	38	19	6	6	7
A. Puerperal sepsis	13	7	2	1	3
B. Postoperative septicæmias	7	4	0	2	1
C. Septicæmias due to other causes	18	8	4	3	3
Group II. Erysipelas	4	4	0	0	0
Group III. Genito-urinary infections, except gonorrhœa	17	9	4	0	4
Group IV. Gonorrhœa	161 (22	64 (14)	73 (7)	0	24 (1)
A. Local	122 (17)	35 (11)	63 (5)	0	24 (1)
B. With arthritis	9 (5)	5 (3)	4 (2)	0	0
C. Chronic myalgia	30 (0)	24 (0)	6 (0)	0	0
Group V. Pneumonia	14	2	10	1	1
Group VI. Local infections	9	5	2	0	2
Group VII. Typhoid	2	0	2	0	0
Group VIII: A. Meningitis (streptococcal)	2	0	0	0	2
B. Epidemic encephalitis	2	2	0	0	0
Group IX. Miscellaneous A. Multiple arthritis	1	1	0	0	0
B. Gas gangrene	1	(0)	1	0	0
C. Persistent infection	1	(0)	1	0	0
D. Ulcerative balanoposthitis	1	1	0	0	0
E. Acute osteomyelitis	1	0	0	0	1
F. Psoriasis	1	1	0	0	0
Totals	255	108 (42.3%)	99 (38.8%)	7 (2.7%)	72 (24%)

taken from the blood was sterile, and after that the patient continued to improve in strength. Subsequent cultures, January 5 and 8, also showed no growth. The patient was discharged from the hospital well on the 10th. When seen in October, 1923, his condition was excellent; the urine was sterile by culture. The rapidity of restoration from apparently imminent death to normal health was almost unbelievable.

CASE 2. Staphylococcus septicæmia, and extensive subcutaneous abscesses following severe injury. Intravenous administration of mercurochrome; sterilization of blood and cure of total infection.

A man, a patient of Dr. Grantham of Asheville, N. C., aged about 30, in previous good health, was injured in the region of the right shoulder by a circular saw. There was an extensive cellulitis of the shoulder region, which extended beneath pectoral muscles, and also down arm and back. The temperature was 104 degrees F. and he was delirious. A slide smear of the wound showed staphylococcus; and blood cultures showed staphylococci in large quantities. Ten cubic centimeters of 1 per cent mercurochrome (dose of only 1.7 milligram per kilogram) were given. Following this he had a chill; the temperature rose to 105, but on the next day was 100, when he received another 10 cubic centimeters of 1 per cent solution intravenously. Two days later, the patient received a third dose (10 cubic centimeters of a 1 per cent solution), on the following day blood cultures were negative, and the patient had an uninterrupted recovery. The cellulitis disappeared;

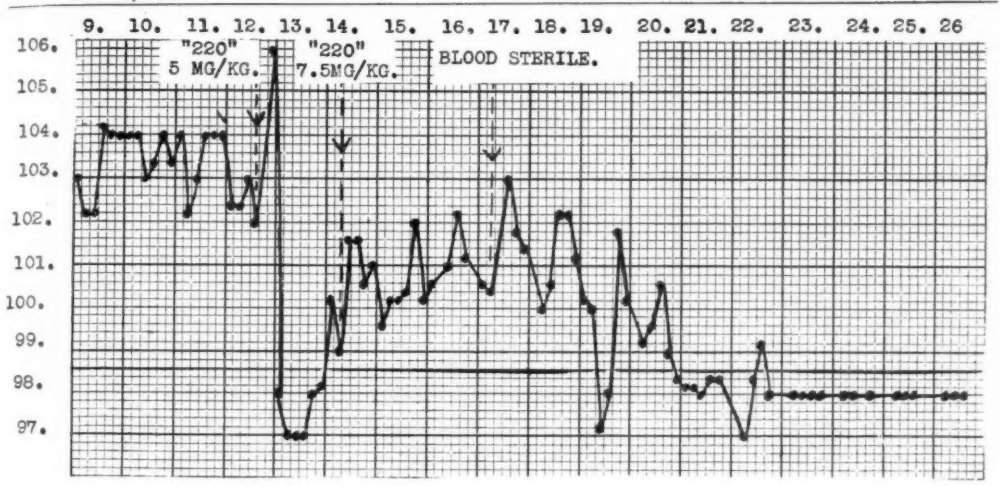

Fig. 1. Case 3. Septicæmia, due to pneumococcus Type IV, following abortion. Recovery after 2 intravenous injections of mercurochrome. Dr. E. B. Freeman.

the wounds healed completely, and the patient was discharged well.

CASE 3. Pneumococcus septicæmia, Type IV, treated with intravenous injections of mercurochrome. Recovery.

D. J., female, age 28, weight 130 pounds, was seen by Dr. E. B. Freeman of Baltimore in consultation with Dr. Cronk of Woodbine, Maryland, on March 3, 1924. On February 16 the patient was taken with "grip." Incomplete abortion followed two days later. This was in the third month of gestation. On the following day curettement was done. The temperature ranged from 97 to 104.5 degrees F. with one or more chills each 24 hours. March 9, 1924, chills and irregular temperature continued. She was at times delirious. Blood culture showed many colonies of pneumococci, Type IV. On March 12, 1924, the temperature was 102 degrees, pulse 130. Mercurochrome 5 milligrams per kilogram (28 cubic centimeters of 1 per cent solution) were given intravenously. One hour later she had a severe chill with temperature 106 degrees F., pulse 160. Twelve hours later the temperature was 97 degrees F., and the pulse 92. The temperature remained subnormal for one day, after which it went up to 102 degrees, (Fig. 1). A second dose of 7.5 milligrams per kilo (35 cubic centimeters of a 1 per cent solution) was given 40 hours after the first injection. There was no reaction. A blood culture was taken at this time which was later reported sterile. The patient improved rapidly. Blood cultures remained sterile.

The subsequent course of the disease proved that no further treatment was necessary, as the temperature and pulse dropped to normal; and the patient had an uneventful convalescence.

CASE 4. Puerperal sepsis. Blood sterilized. Recovery.

Case of Dr. H. H. Trout, Roanoke, Virginia. The patient was admitted to the hospital, very septic, blood culture showing many colonies of Gram positive diplococcus, Gram positive streptococcus and an organism taken to be a pneumococcus. Death being expected before morning, the patient was given 5 milligrams per kilo of mercurochrome intravenously. The next day she felt better, but a second injection of 5 milligrams per kilo was given. Blood cultures after the first injection were sterile. A pelvic abscess which was present was opened by vagina. Seven hundred cubic centimeters of pus aspirated from her chest showed pneumococci predominating. The patient recovered and Dr. Trout believes the drug saved her life.

CASE 5. Puerperal Septicæmia. Blood cultures, staphylococcus. Recovery.

Case of Dr. J. B. Comfort, St. Francis Hospital, Hartford, Connecticut. The patient, 25 years of age, weight 130 pounds, after a normal labor began to have chills and fever. On the thirty-second day she had a severe chill, with temperature 106 degrees F., pulse 160, respiration 48, leucocytes 18,000, erythrocytes 2,500,000. Blood culture showed staphylococcus. A diagnosis of septic phlebitis of femoral veins and staphylococcus septicæmia was made.

Two days later an injection of 20 cubic centimeters of 1 per cent mercurochrome (3.4 milligrams per kilogram) was followed by a severe reaction. The patient was pulseless. Heat and stimulation were applied. The next day the temperature dropped to 101 degrees F.

Four days later a second injection was given of mercurochrome 20 cubic centimeters. Five days after the second dose there was a chill, with pulse 160, temperature 105.2 degrees, respiration 48, and it was decided to give mercurochrome until a negative culture resulted. Four injections were given of 30 cubic centimeters each (5 milligrams per kilo) the first 2, 3 days apart; the second, third, and fourth, 48 hours apart. This caused looseness of teeth, slight bleeding of gums, and diarrhœa, but after the first of these last injections the temperature came down to 101 degrees; pulse, 140; respiration, 32. The blood culture taken 48 hours after the last injection was negative as were subsequent cultures. The temperature remained normal. Recovery was uneventful except for swelling of leg.

CASE 6. Septicæmia, pneumonia. Gentian violet and mercurochrome. Recovery.

Case of Dr. O. P. Schaub,[1] Winston-Salem, N. C. The patient was a girl, aged 7. After a mastoid operation, blood cultures were positive for streptococcus, the temperature curve was septic, 4 days after operation the lungs became involved.

On the 25th day after operation, 10 cubic centimeters of ¼ per cent gentian violet were given intravenously with 2 other injections of 25 cubic centimeters of ¼ per cent the following days. One week later 7 cubic centimeters of mercurochrome 1 per cent was followed by slight reaction. Four days later the blood culture was negative and remained so. Convalescence was stormy; a pyothorax was aspirated, there was a bronchial fistula, an operation for arthritis of the hip, and there were numerous subcutaneous abscesses, but finally the patient got entirely well.

CASE 7. Scarlet fever. Erysipelas, septicæmia. Mercurochrome. Recovery.

Case with Dr. Birkhaug.[2] The patient, a male, age 4 years, with scarlet fever, was given Dochez' antistreptococcic scarlatinal serum, 40 cubic centimeters intramuscularly. This injection caused a slight drop in temperature, from 104 to 101.6 degrees F. and pulse from 140 to 100 but did not relieve toxic symptoms, and erysipelas developed over the face.

Three days later the temperature was 105 degrees F., pulse 140. The child was irrational and unable to take food. Blood culture showed streptococcus hæmolyticus, 38 colonies per cubic centimeter. The urine contained cocci, pus, casts and albumin. He was then given 15 cubic centimeters of a 1 per cent solution of mercurochrome (7.5 milligrams per kilo, a very large dose regardless of nephritis).

The next day the condition markedly improved, and the child was able to talk and eat. The blood was completely sterilized as early as 12 hours after drug injection as shown by three negative blood cultures. The temperature fell from 105 degrees F. to 101 degrees F. within 15 hours after injection and the pulse, from 140 to 98. Reaction was slight.

On the next day the erysipelas was almost gone, the swelling of the tonsils and glands of the neck was much less, and the blood culture sterile. The patient rapidly recovered completely. Albumen casts and cocci disappeared from the urine. He was discharged well on the tenth day.

CASE 8. Pneumonia. Septicæmia. Arthritis. Mercurochrome. Cure.

Case of Dr. George Martyn, Los Angeles, Calif. The patient, a female, had pneumonia, beginning with the left lower lobe, with swollen, painful joints, following a dental extraction. After several days the right lower and middle lobes became involved. Temperature 102 to 104 degrees. Blood cultures showed streptococcus hæmolyticus, no pneumococci. On the day of treatment the temperature was 104 degrees, pulse 140; the patient was "sinking rapidly and cyanotic, every joint was swollen."

She was given 20 cubic centimeters 1 per cent mercurochrome intravenously, 5 milligrams per kilo. Within an hour a severe chill began which lasted 3 hours, the temperature going to 105 degrees F., then followed profuse perspiration and sleep. The next morning the temperature was 99.6 degrees F., pulse 96. There was immediate cessation of all joint symptoms. There were eight bowel actions in the first twelve hours. The temperature remained below 100 degrees. Recovery was complete. Dr. Martyn says: "There is no doubt that this drug saved her life."

CASE 9. Bronchopneumonia. Mercurochrome. Cure.

Case of Drs. Freeman and Hoppe.[3] Patient, female, aged 5½ years, weight 12 kilograms, developed measles, followed by bronchopneumonia and acute otitis media. For six weeks the temperature ran from 102 to 105 degrees. During the fourth week she developed severe diarrhœa with 5 to 7 stools daily. On the thirty-eighth day the condition was desperate; there were 5 separate areas of consolidation in her lungs, temperature 104.6 degrees F., both ears were discharging profusely; there were numerous skin abscesses, "respiration labored and cyanosis severe. Hope for her recovery was abandoned."

She was given 5 milligrams per kilo mercurochrome intravenously, with little systemic reaction. The temperature fell as if by crisis (Fig. 2) and a rapid and uninterrupted recovery began. The stools were stained red for 2 days, but the diarrhœa rapidly disappeared. The skin lesions improved. We have never seen a more spectacular recovery.

CASE 10. Acute mastoiditis. Left lateral sinus thrombosis. Endomyocarditis. Mercurochrome. Recovery.

Case of Dr. F. Arthur Emmett, Hartford, Connecticut. The patient was operated upon for an acute mastoiditis and a left lateral sinus thrombosis. The sinus was opened and the jugular vein tied off. Following this the boy developed an endomyocarditis. He had high temperature, the pulse rate was 130

[1] Schaub, O. P. Eye, Ear, Nose & Throat Month., May, 1924.
[2] Young, H. H., and Birkhaug, K. J. Am. M. Ass., 1924, lxxxiii, 492–494.
[3] Am. J. Dis. Child., 1924, xxviii, 310.

most of the time, and the heart apparently had a malignant infection. The initial infection was staphylococcus.

"Careful study of the results of your researches led me to use mercurochrome, 15 cubic centimeters of a 1 per cent solution. The temperature and pulse dropped to normal; and during the month that he remained in hospital he gained 13 pounds. I think that his heart infection has entirely cleared up as he had no more cardiac symptoms."

CASE 11. Aortic endocarditis. Rheumatic fever. Mercurochrome. Recovery.

Case of Dr. F. B. Bowman, Hamilton, Ontario, Canada. Female, aged 22, entered hospital in a very serious condition, 2 consultants pronouncing her case hopeless. There was a rough blowing aortic murmur, the temperature was 101 to 103 degrees, pulse irregular and 120. There were periods of cyanosis, with swollen painful joints.

Blood culture showed streptococcus hæmolyticus. She was given 3 doses of mercurochrome (5 milligrams per kilo). The temperature became normal, pain and swelling left the joints, and the blood culture became negative. The patient left the hospital in two weeks' time quite well, except for soft blowing murmur in the aortic region. When last heard from, she was well, dancing and exercising. "I am convinced that mercurochrome saved this girl's life."

CASE 12. Furunculosis. Sepsis. Mercurochrome. Improvement.

Dr. R. Sanmartin, Bogotá, Colombia, himself, developed a case of furunculosis. These abscesses were opened but the fever continued with symptoms of septicæmia and formation of a deep abscess in the hypogastric region.

He received 20 cubic centimeters (3 milligrams per kilo) of 1 per cent mercurochrome, with strong reaction, but on the following day the temperature did not rise above 38 degrees C.; the chills and vomiting ceased. Three days later he received a second injection of 15 cubic centimeters (2.2 milligrams per kilo) with less general reaction. Six days later the chills and fever and the swelling in the abdominal region reappeared, and the patient was given 2 more injections, one of 10 cubic centimeters (about 1.4 milligrams per kilo) with little reaction and a final one of 20 cubic centimeters (3 millimeters per kilo) which gave a violent reaction lasting 12 hours. "These last two injections produced a marvelous effect as it enabled me to take a trip of 500 miles in a hydroplane to Bogotá to have the deep abscess

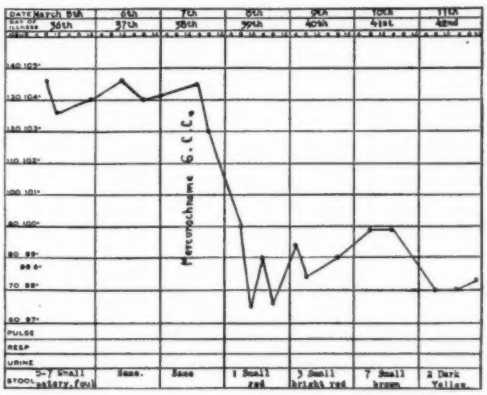

Fig. 2. Extensive bronchopneumonia. Five separate areas of consolidation, multiple skin abscesses, severe diarrhœa, and double otitis media.

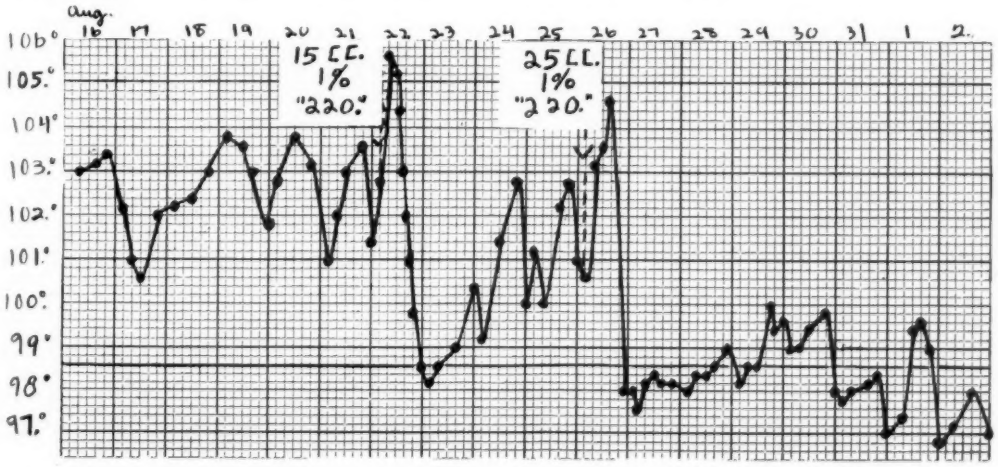

Fig. 3. Typhoid fever. Two intravenous injections of mercurochrome, 1 of 2.6 milligrams per kilogram, and 1 of 4.4 milligrams per kilogram, both followed by marked improvement in condition. Rapid recovery followed. Dr. H. P. Linn.

opened, after which I recovered completely. I have also cured with mercurochrome 2 cases of puerperal septicæmia and one of furunculosis."

CASE 13. Gonorrhœa. Prostatic abscess. Mercurochrome. Cure.

Case of Drs. Potee and Redewell, University of California. L. S. S., seaman, second class, aged 22, was admitted July 17, 1924, with retention of urine. There was a history of gonorrhœa acquired February 20, 1923. Examination revealed an enormous prostatic abscess and a urethral discharge with gonococci present.

Treatment. The patient was catheterized to relieve the vesical tension. The following injections of mercurochrome 1 per cent solution were given intravenously: July 19, 1924, 10 cubic centimeters; July 21, 1924, 15 cubic centimeters; July 23, 1924, 20 cubic centimeters; July 25, 1924, 20 cubic centimeters. All discharge from the urethra stopped after the third intravenous injection, but expressed secretion from the prostate and seminal vesicles still contained 100 white blood cells to the field, and gonococci were present. After six injections the patient reached mercurochrome saturation. On August 18, 1924, the prostate was normal in size and firm in consistency; expressed secretion contained an occasional pus cell; and the urine was free from shreds. Instrumentation and injection of ½ per cent silver solution did not produce a return of symptoms nor a positive smear. Patient was discharged as cured.

CASE 14. Typhoid fever. Mercurochrome. Apparent cure.

Case of Dr. H. P. Linn, Paducah, Kentucky. Male, aged 19, weight 125 pounds, entered the hospital with a diagnosis of typhoid fever made by positive Widal. Next day he was given 15 cubic centimeters of 1 per cent mercurochrome intravenously (2.6 milligrams per kilo) which was followed by vomiting, and chill, after which the temperature went to 105.6 degrees, then dropped to 98.6 degrees in 12 hours after injection. Five days after the first injection he received a second of 25 cubic centimeters (4.4 milligrams per kilo) of 1 per cent solution, followed by vomiting, chill and temperature of 104.6 degrees, then a drop to 98 degrees eleven hours after injection, after which it remained low (Fig. 3).

"The day following each mercurochrome treatment his condition was markedly improved." Finally he completely recovered.

CASE 15. Peritonitis. Mercurochrome. Recovery.

Case of Drs. Roeder and Judd, Omaha, Nebraska. Patient, male, aged 41, 24 hours after "drainage of a retrocæcal appendiceal abscess, a picture of advancing peritonitis was very evident. The pulse rose steadily to 130, and temperature to 102 degrees F. Thirty cubic centimeters of a 1 per cent solution of mercurochrome were injected intravenously, followed by a rise in temperature to 104 degrees, with diarrhœa. In 40 hours the temperature was 99 degrees, and the pulse 80. The change was so striking that it was evident that mercurochrome was the deciding factor."

CASE 16. Retroperitoneal abscess following bladder instrumentation. Colon bacillus infection. Intravenous injection of mercurochrome. Rapid disappearance of abscess.

J. H. D.,[1] a youth, aged 17, admitted June 21, 1923, had a hypospadias, for which a plastic operation was done to close the defect. The convalescence was uneventful until July 14, the twenty-third day, when, following the passage of sounds, the patient had a chill and fever which reached 101.5 degrees F., as shown in chart (Fig. 4). On the following day the patient was very ill and the temperature 104 degrees. There was pain in left side of abdomen and muscle-spasm and tenderness on pressure. A diagnosis was made of retroperitoneal abscess. On the next day the muscle spasm and mass had increased. The temperature at 8 a. m. was 103.5 degrees. Urinalysis showed colon bacilli. Ordinarily the patient would have been subjected to immediate incision and drainage of the abscess, but we decided to try an intravenous injection of mercurochrome, and 27 cubic centimeters of a 1 per cent solution, 5.4 milligrams per kilo, was given at 11 a. m. At noon the temperature was 106, and the patient had a severe chill, but by midnight it had dropped to 99.6, and after that remained practically normal (Fig. 4). On the following day the patient was free from pain, muscle spasm had almost disappeared, and he went on to a rapid recovery without operation. One year later the patient was quite well, and the urine was sterile.

CASE 17. Chronic ulcerative balanoposthitis. Mercurochrome and gentian violet. Cure.

B. U. I. 12056. R. F. B., male, aged 28, was admitted January 11, 1924, complaining of sores on the penis of six months' duration. The ulcers had been treated in various clinics where X-ray, nitric acid, tartar emetic and numerous other forms of therapy had been tried and had failed. The ulcers were excruciatingly painful and morphia was necessary. The Wassermann was negative, leucocytosis 13,200. His condition was so desperate that he threatened suicide.

Cultures from the wound showed Gram positive cocci, pseudopyocyanei and Gram negative bacilli. He was first given an intravenous injection of 5 milligrams per kilo of gentian violet. There was no improvement. Five days later he received 5 milligrams mercurochrome per kilo. Within two hours pain began to decrease and the next day, for the first time he was free from pain. Two days later mercurochrome, 5 milligrams per kilo were given. The ulcers then began to clear up and heal. Twelve days later an intravenous injection of mercurochrome was again given and when he left the hospital eight days subsequent to the last treatment the ulcers had disappeared, epidermization was complete, he was free from pain, had quit morphia, and gained in weight.

[1] Young, H. H. Johns Hopkins Hosp. Bull., 1924, **xxxv**, 14.

The experimental work with my collaborators on which our clinical studies were based, has been published in numerous papers; suffice it to say briefly that we have shown in animals that mercurochrome kills bacteria in 1 minute in blood serum at a strength of 1 to 600; that the blood and urine and bile can be rendered bacteriostatic if not germicidal, and that rabbits stand 5 milligrams per kilo and dogs 10 milligrams per kilo repeatedly without fatality or apparent injury, and that no kidney lesions are found in animals sacrificed, except slight cloudy swelling.

CONCLUSION

As to dosage and reactions it is difficult to draw conclusions. Two patients, both hopeless cases, have died, one immediately after and the other the next day after intravenus injection of mercurochrome. Among 89 cases in which I have careful notes, there was a very severe reaction in three septicæmia cases which seemed hopeless. The intravenous injection of mercurochrome was followed by a fearful chill, very high temperature, and the patient went into a condition of extreme shock. One became pulseless. But all three got well, and the reporters think the drug saved them.

In 28 cases a severe gastro-intestinal reaction occurred, nausea, vomiting and many stools, some tinged with blood. A few patients got stomatitis, one of mine very severe—but he was cured of a furunculosis which had lasted six months.

Many physicians have used small doses (1 to 3 milligrams per kilo) and where they have repeated them have obtained some brilliant results. Other patients, treated with small doses, have died. Some of these patients might have been saved by a larger dosage. In one of my most desperate septicæmia cases, although acute nephritis was present (Case 7), the huge dose of 7.5 milligrams per kilo was used and undoubtedly saved the child's life. In most of our cases the effect on the kidneys has been slight. One case receiving 6.8 milligrams per kilo had albumin and a few casts for 5 days. Other cases with pyelonephritis have developed clear urine. Animal experiments show no marked nephritis, not even when killing doses are used.

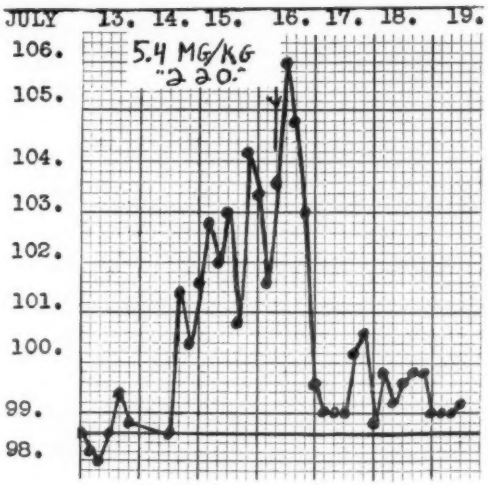

Fig. 4. Retroperitoneal abscess following bladder instrumentation. Colon bacillus infection. One injection of 5.4 milligrams per kilogram was followed by marked improvement and recovery without operation.

That nephritis might occur I will not deny. Mercurochrome contains 26 per cent mercury, but in the form of a compound hydroxymercury-dibromfluorescin which is remarkable for its non-irritating and non-toxic effect on blood-vessels, tissues, viscera, and wounds.

In common with all mercurials, however, the reaction to its use is not absolutely uniform. Some patients have had stomatitis from a very small dosage, and gastro-intestinal disturbances which usually occur after large doses (5 to 7 milligrams per kilo) sometimes do not occur at all. Very large and very fat patients should have less.

All intravenous medication requires great care. Mercurochrome is no exception. It can produce violent reactions, but some cases require big doses to save them, and perhaps the high fever assists in the case.

I will quote Roeder and Judd on these points: "From an experience based upon fifteen cases we may come to the definite conclusion that in a good percentage of acute fulminating infections, mercurochrome therapy has a place provided it is administered while the patient is still displaying a resistance. Mercurochrome requires assistance on the part of the body economy. We have also

noted that the greater the reaction obtained the more favorable the result. Temperature rising to 106 or 107.5 degrees F., with the urine, vomitus, and frequent fæcal movement colored with the dye may appear alarming but in our experience such patients have received the best results and have been harmed in no way with the exception of a salivation which has disappeared in a short time. If the mercurochrome-220 does not destroy or retard the growth and activity of the dominating infecting organism it stirs up a resistance or a reaction which in turn destroys the bacteria."

What are the limitations and what may be expected of mercurochrome injected intravenously? I cannot say. It is too early. I hope soon to have sufficient cases to standardize the treatments somewhat. In many of the cases the patients were almost moribund. Most of these have died. A few marvelous recoveries have occurred, and their physicians think the drug saved these lives. Summarizing the cases from physicians who have sent me personal reports and our own cases, I find that the treatment has cured or contributed largely to the cure of the following: 25 cases of septicæmia; 2 cases of meningitis, 2 of epidemic encephalitis; 12 cases of pneumonia; 1 of general peritonitis, 1 of retroperitoneal and 1 of perinephritic abscess; 4 of erysipelas; 1 of furunculosis. In many cases of arthritis and in some cases of local wound infections, including a case of gas gangrene, the results were immediate, but it was impossible to say positively that the drug was responsible for the rapid recovery made. In many cases it frankly failed; this was particularly true in streptococcus viridans endocarditis, and bacillus coli pyelonephritis. In 15 staphylococcus cases—10 cases of general septicæmia; 4 cases of infection of the genito-urinary tract; and 1, osteomyelitis—it only failed with 1 case (osteomyelitis). Its use in venereal infections is most promising. In many cases it is difficult to interpret the clinical results, and the skeptical will decide that nature cured them while enthusiasts, like myself, may attribute it to mercurochrome. But making every allowance I believe I can safely say that it has already saved many lives, and has assisted the body defences in throwing off grave local and general infections. Intravenous therapy does not supplant surgery, but it may be of vast assistance and turn the tide for the patient.

SUBCUTANEOUS EMPHYSEMA FOLLOWING LABOR

Report of a Case

By PIERRE N. CHARBONNET, M.D., Tulsa, Oklahoma

EVERY obstetrician and every general practitioner interested in maternity work has learned from some not too pleasant experience, the number of frequently alarming symptoms that may present themselves during or following some otherwise perfectly normal case of labor. The anxiety that these symptoms can produce in an already harassed brain are commensurate only with the intense relief that follows when their subsidence is as rapid and complete as the onset was abrupt and alarming.

The following case is in a way an illustration of this condition. It is, I believe, unique, inasmuch as I have not known a similar case, nor have I been able to find mention of one in all the literature.

Mrs. C. W. G., a primipara, American, age 18 years, married 1 year and 7 months, consulted me on January 11, 1924, in about the seventh month of pregnancy. She felt perfectly well, had been but slightly nauseated at the beginning of conception, and seemed in every way perfectly normal.

The family history was negative. The father is living. Two brothers and two sisters are living and well. The mother died several years ago, 6 months after the birth of her youngest child; the cause was unknown. There was no history of cancer, tuberculosis, or hæmophilia in the family.

The previous history with the exception of a mild case of smallpox 5 years ago (there were no scars visible) was negative. To her knowledge there had been no complications. Her periods started at 14 years, and were always regular, the duration being 5 to 6 days, with slight pains at onset. She had had no previous conceptions and no miscarriages. Her last period was June 22, 1923. The estimated date of confinement was March 29, 1924. She had not noted the onset of quickening.

Physical examination revealed a well developed and well nourished young female in the seventh month of pregnancy. The skin was clear; heart and lungs were normal. The breasts were well formed with good nipples. Abdominal examination revealed a uterus reaching slightly above the umbilicus. There was no tenderness and no rigidity. Vaginal examination showed the uterus well out of the pelvic cavity, no obstructions and the passages apparently were perfectly normal. The pelvic measurements were within normal limits. The blood pressure was systolic, 150; diastolic, 90. The urine was negative.

She was seen several times between this date and March 3, on which date her blood pressure was 160, systolic, and the urine showed a trace of albumin. She was given a saline purge, alkalies, and instructed to abstain from meats.

On March 10, the albumin had risen to ½ per cent, and the blood pressure was 165. She was put to bed on a milk diet and eliminative treatment. On March 17, the blood pressure was 180 and the albumin 1 per cent. There was slight œdema of the feet and face. There was no headache, and no visual disturbance.

Labor pains began in the early morning of March 18. There was some dilatation of the cervix, and the pains were regular, at 5 minute intervals. The blood pressure was 240 systolic. Morphine sulphate, ¼ grain was administered. I urged that she be taken to a hospital in case interference became necessary; but thanks to the expostulations of a mother-in-law who "had cared for hundreds of baby cases without any trouble," this was refused. On insisting, as an alternative, I was grudgingly allowed to send out a nurse and to place her in charge.

The pains continued regularly and the patient was in good condition. At 7 p.m. the systolic pressure had dropped to 190 and at 9 p.m. was 180. At 11 p.m. the pains became more frequent. The cervix was well dilated, the patient working with her pains. As the contractions became stronger, she worked, bearing down possibly a bit more strenuously than in the average case, but never at any time violently. She refused an anæsthetic. She was delivered of a male child, weighing 9½ pounds at 3 a.m., an episiotomy having been done for the passage of an unusually large head. The placenta and membranes were expelled intact by Crede's maneuver and the episiotomy wound repaired.

The patient seemed in good condition. The blood pressure was 180. She complained of slight pain in the neck, intensified by swallowing. Her face seemed a bit swollen, but as there had been some œdema, this was assigned as the cause and the pain the result of the straining during labor.

She was again seen early in the morning and complained of considerable distress in breathing. The pain in the neck was more severe and was accentuated by the act of swallowing. Examination to my great surprise revealed a subcutaneous emphysema extending from the level of the second costal cartilages on the anterior aspect of the chest and anterior surface and both sides of the neck and face up to the level of the external auditory orifice. There was also some emphysema of the tissues inside the mouth and throat. There was no discoloration and the characteristic crackling could be elicited on pressure. Her pulse and temperature were normal. The respiration

was slightly labored. The blood pressure was 174 systolic. Examination of the chest was negative. She was placed in a semirecumbent position and given hot liquids. Hot applications were made over the emphysematous areas. She experienced considerable relief.

She was kept under close observation. The temperature remained normal, and the blood pressure gradually came down to 160 where it has remained to date. The emphysema gradually subsided, but did not disappear entirely until the eleventh day; the area over the anterior surface of the chest was the last to disappear. The remainder of the puerperium was normal. She was able to nurse the baby.

Dr. D. M. MacDonald, who saw the case with me at my request, confirmed my findings, but was able to offer no explanation.

I have heard of emphysema occurring following very violent exercise and it is possible that this condition was simulated here. However, it does not seem likely that the mere strain of bearing down with her pains, which while a bit stronger than in the average case, was never violent, could have produced this condition. Were it possible to produce a rupture of the lung or alveoli in this fashion, would it not seem more likely that the result would be a pulmonary emphysema or a pneumothorax rather than such a condition as actually occurred? There was no evidence of fracture of any rib, and the examination of the chest revealed nothing abnormal. It has been suggested that there might have been in this patient a bronchial fistula. This does not seem likely, and if one existed would it not have manifested itself earlier in life?

Another interesting feature of this case was the gradual rise in blood pressure in spite of the treatment instituted, and the sudden drop that occurred following the administration of morphine and the advance of the second stage. Is it possible that there could have been some connection between the blood pressure findings and the emphysema? This does not seem likely.

I believe this case justifies our attention. While I do not doubt that the condition has occurred before, the fact that a search of the literature has failed to disclose mention of a single case attests that it is at least rare. It is also an interesting illustration of the unusual and unexpected that too frequently occur in even the most normal cases of labor.

GRANULOMA INGUINALE[1]

By WILLIAM S. EHRICH, M.D., F.A.C.S., Evansville, Indiana

AFTER reading the literature on granuloma inguinale, we find that this disease is not so uncommon as, at first thought, we would believe. In fact, though the disease has been considered as belonging to the tropics, it is shown by the wide spread geographical distribution of the cases reported that sporadic cases have been seen throughout the entire United States.

Randall has reported cases from Pennsylvania and New Jersey; Symmers, Frost and Campbell from New York; Rose from Virginia; Lynch and Weinberg from South Carolina; Reed and Wolf from Louisiana; Walker from California; Young from Kentucky; and Claassen from Ohio. One might suspect that the cases in the large sea board cities could have been imported, but the general distribution, especially in the central states, leaves something to be explained.

I shall not go into a detailed description of the disease since this has been taken up very fully by the writers mentioned above, but I wish to call attention to a few of its outstanding characteristics.

The original lesion, beginning as a papule, breaks down leaving a raw surface from which is exuded a serous fluid. Then follows a gradual extension, either excentrically, or new lesions may appear in the vicinity, probably due to auto-inoculation. There is a proliferation of granulation tissue which is more or less flattened giving the impression of a sunken center. While the lesion cannot be described as an ulcer neither is there such an excess of tissue as to class it with those lesions characterized by extensive overgrowth.

One of the most striking characteristics of this disease is the absence of adenopathy. The lack of constitutional symptoms due to the disease is also remarkable. The predominance in the negro race is pointed out by all writers, in fact, with the exception of my own case, there have been but three reported in white subjects. Donovan's bodies are found in a certain proportion but not in all cases. The tendency to spread, unchecked by any medical or surgical treatment except tartar emetic, is also distinctive.

Case. J. J. R., white, male. age 23 years; nativity, Ohio, but has resided in Owensboro, Kentucky, for the past year, an employee of a construction company, reported for treatment November 15, 1923. He complained of sores on penis and mons veneris. He has never had any serious illness. The family history is good. He denies having had syphilis but admits previous gonorrhœa. He has had acne for some years. Sore on penis started as a small itchy papule which was squeezed and afterward broke down. There has always been a serous discharge but never a great amount of pus. The lesion at this time was about 3 weeks old. He had had intercourse 3 days before he noticed the lesion but previous contact was 3 or 4 months. (Effort was made to examine the last woman but she could not be found.)

Examination, a well nourished and developed man, blonde, normal in every respect except an acne and a lesion on the shaft of the penis near the distal end about 1.5 centimeters in diameter. Another similar lesion was found on the mons. These were flat and the bases, especially of the one on the mons showed granular elevations. Dark field examination did not reveal treponema pallida nor were Ducrey bacilli found. Since antiseptics had formerly been used the lesions were left alone for several days when another examination was made and was likewise negative. Sufficient time having elapsed a

[1] Read before Lancet Club, Evansville, Indiana, February 1924.

Wassermann test was made and was negative. Smears from the secretion showed leucocytes and a large mononucleated cell which contained an encapsulated clubshaped bacillus. Guinea pig inoculation was negative. No satisfactory results were gotten from cultures. These lesions were sensitive and painful.

Treatment. After the material for examination was obtained the lesions were swabbed with mercurochrome 4 per cent and kept moist with a weak cyanide of mercury solution upon which they thrived, increasing in size continuously. At this time two other lesions appeared, one on the proximal end of the penis and another on the mons. Sulfarsenol (Pluchon) .36 given intravenously made no impression. At the same time thymol iodide locally failed to check the spread. The patient was then saturated with potassium iodide with no result. Tartar emetic, 1 cubic centimeter of a 1 per cent solution was given intravenously, on December 31, January 2, 4, 6, and 8, and 1.5 cubic centimeters on January 10, 12, 15, 20, 25, and February 1. After the second injection the patient was relieved of his pain and the lesions began to look more healthy. From this time the progress was continuous until the fifth when islets of epithelium appeared and after the eighth the lesions were covered with epithelium. Three more injections were given as insurance against relapse and the patient discharged with instructions to be on the alert for any other lesions and to return at once should one appear.

Comment. The amount of tartar emetic used by others was 1 cubic centimeter of a 1 per cent solution and in some cases it was carried up to 14 cubic centimeters at one injection. In this case the larger amounts were not necessary since response was prompt and continuous.

The preparation of the injection was solution in freshly distilled water, and, since we did not have sufficient familiarity with the drug to be sure of its ability to withstand boiling without deterioration, it was brought to the boiling point several times but not boiled.

Some writers have noted both general and local reactions but there were none in this case. Perhaps on account of the small amount of drug used there was no general reaction and the absence of local might have been due to the fact that before the solution was injected into the vein a small amount of blood was withdrawn into the syringe and the mixture injected.

Nothing is mentioned regarding the mode of infection and therefore I exerted every effort to find the woman in the case. If the infection is through sexual contact, as the location of the lesion would naturally point, then the incubation must be very short, 3 days, or, it must be very prolonged, over 3 months, as these were the periods given, truthfully I believe, by the patient.

After having studied this case I am convinced that there have been other cases in this section and am quite sure that I have failed in the diagnosis of at least one previous case.

A negro came in on my service at St. Mary's Hospital with lesions on the glans and prepuce. These were of many months' duration. Dark field, Wassermann, and Ducrey were all negative. Salvarsan, potassium iodide, actual cautery, and local antiseptics gave no result. The patient eloped from the hospital and was not heard from for several months when he was returned by the police because of insanity and was transferred to the Southern Indiana Hospital for the Insane. I later got in touch with the patient and through the courtesy of the physicians of that institution tartar emetic was administered up to 5 cubic centimeters of the solution at one injection. The lesion ceased spreading and shows some improvement, but there is a large area uncovered. After a rest for 6 weeks from treatment there is a tendency in one place to break down.

CONCLUSIONS

In conclusion I would suggest that antimony and potassium tartrate may be used as a therapeutic test in making a diagnosis, as well as in treatment, where it is specific, since it is practically free from danger in small dosage and is easily administered.

I would also suggest that all cases of lesions in the inguinal triangle, especially in the negro, which are negative to tests for both syphilis and chancroid, and are resistant to all forms of treatment, be suspected of being granuloma.

REFERENCES

I wish to thank Dr. W. C. Caldwell for his assistance in the pathological work in this case.

RANDALL, ALEXANDER, SMALL, JAMES C., and BELK, WILLIAM P. Granuloma inguinale. Surg., Gynec. & Obst., 1922, June.

LYNCH, KENNETH M. Granuloma inguinale. J. Am. M. Ass., 1921, lxxxvii, 925.

REED and WOLF. New Orleans M. & S. J., 1921, July.

SYMMERS and FROST. J. Am. M. Ass., 1920, May.

CLAASSEN. Ohio St. M. J., 1922, Oct.

RANDALL. Am. J. Urol., 1923, June.

WEINBERG. Am. J. Urol., 1923, June.

DEPARTMENT OF TECHNIQUE

A NEW PROCEDURE FOR THE RELIEF OF FACIES SCAPHOIDEA —DISH FACE[1]

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THE condition known as dish face constitutes a very striking deformity of the acquired type and is characterized clinically by a prominence of the forehead, a recession of the mid-face and with it the lower half of the nose, a lengthening of the upper lip, and a prognathic chin.

The etiology is not well known; in fact not much is to be found concerning the subject. The most striking fact in the pathology of the condition is the small size of the upper jaw. There is a lack of development in it both laterally, vertically, and anteroposteriorly. The dental arcade is narrow and shorter than that of the lower jaw and in malocclusion with the latter. The lower incisors in occlusion project beyond the upper and the cuspids and remaining teeth do not occlude properly. The upper lip looks too long. This is partly because the gum of the upper jaw is not developed sufficiently to carry the lip forward nor is the vertical height of the jaw sufficient to bring the cutting edge of the upper incisors down to the level of the free border of the upper lip. Hence there is a tendency for the edge of the upper lip to "fall in" as in those faces in which the upper incisors have been lost. This leads to a habit that most of these patients have of "sucking in" the upper lip or of biting it, which of course does not tend toward the diminution of the deformity either of lip or jaw.

The teeth in the upper jaw are often badly arranged and this is not surprising since the teeth, normal in size and number, must fit into an arch that is too small. In fact some of the teeth may fail entirely to erupt.

The deformity of the nose is very striking. It is pinched; that is, the alæ have not the normal roundness nor flare and the nasal apertures are merely narrow slits about the same width from tip to base. There is a distinct "hump" but not because of a local overgrowth of septum or roof but because the root of the nose has been carried forward normally by the developing frontal and nasal bones while its lower half has been held back fastened as it is to the non-developing upper jaw. The tip is on a coronal plane only slightly anterior to that of the hump (osteochondral junction).

If the child can be treated early a skillful orthodontist can so change the dental arcade that the deformity almost disappears. The cheeks and lips can be carried outward and forward as the teeth are moved. Even the deformity of the nose is lessened. It is necessary for the child to wear appliances which are adjusted and changed from time to time for two years at least and the patient during this time should be seen by the doctor at

Fig. 1. Profiles taken before and after operation.

Fig. 2. Full face views taken before and after operation.

[1] Received for publication April 15, 1924.

Fig. 3

Fig. 4

Fig. 5

Fig. 3. An incision through the skin and soft parts including the periosteum was made between ala and lip, up into the nostril just out of sight down along the septum in the angle between it and the floor of the nostril across the columnella where it joins the lip and up into and out of the other nostril in the same way.

Fig. 4. The soft parts were retracted and the periosteum elevated from the upper jaw around the lower half of the nasal aperture. The nasal spine was cut through at its base and the mucoperichondrium of the nasal floor and septum was elevated back for about 2 centimeters.

Fig. 5. The piece of cartilage is inserted into the prepared cavity, costal end up and split surface turned toward the bone.

least once a week. The treatment is slow and expensive but in a child under fifteen or sixteen the results are really worth it.

About all the surgeons have had to offer so far has been some kind of operation directed to the nose. Either the hump was removed or else a bit of cartilage was inserted as a sort of ridge pole from tip to hump. Sometimes the tip too was shortened.

The procedure adopted in the case here reported after the lapse of a year has seemed to give a result such as I never before have obtained and I feel that it may be worth publishing. I do not know that it has been done before.

The patient was 18 years old and before resorting to operation I had a consultation with Doctor Ruckstuhl as to the advisability of his trying to correct the deformity (orthodontia). The patient's father decided it could not be done and asked for a surgical method.

It seemed to me that if I could detach the cartilaginous part of the nose from the nasal aperture in the upper jaw particularly in its lower half, and at the same time divide the septum from below upward for at least half way from floor to roof, I might be able to lift the whole lower part of the nose forward. If so I could hold it there indefinitely by transplanting cartilage under it. It would have been necessary however to do all this with a minimum amount of scar and in the most certain possible way. I considered doing it through the mouth but at the last moment for fear of failure I abandoned the idea and proceeded as follows.

An incision through the skin and soft parts including the periosteum was made between ala and lip, up into the nostril just out of sight down along the septum in the angle between it and the floor of the nostril across the columnella where it joins the lip and up into and out of the other nostril in the same way and lastly between ala and lip. The soft parts were retracted and the periosteum elevated from the upper jaw around the lower half of the nasal aperture in the jaw. The nasal spine was cut through at its base and the mucoperichondrium of the nasal floor and lower half of the septum was elevated back for about 2 centimeters from the nasal spine. The septum was now divided by an incision which began just behind the nasal spine and extended upward and backward for about 2 centimeters. All bleeding—there was not much—was controlled by pressure. The mouth and nose were now examined for free blood. None was present. This showed that we had been successful in not going through the mucosa and might safely transplant the cartilage.

A portion of the fifth rib, 1.5 centimeters in length, with its attached cartilage, 3 centimeters

in length, was removed from the right side. The periosteum and perichondrium were left on the transplant. It was then split on the edge. The fragments at once curved as they usually do convex lengthwise on the split surface. The sharp angles were now rounded off and a hole was bored through the cartilage end of each and a strand of No. 1—20 day catgut was run through the holes of one. This piece was now inserted into the prepared cavity, bony end first and the split surface was turned toward the denuded surface of the upper jaw. The second piece was now threaded on the catgut and it likewise was inserted in the same manner. It was not difficult to push the bony ends up along the nasal process of the superior maxilla. A very pleasing thing noted was that the natural curve of the rib cartilage which curved up convex along the lower edge at the osteochondral junction caused the pieces when so placed to more readily adapt themselves to the procedure and lifted the nose forward without even slightly encroaching on the lumen of the bony aperture. When both bony ends had been well pushed up along the anterior aspect of each nasal process of the superior maxilla the cartilaginous ends were drawn together and the catgut on which they had been "strung" was tied. Their tips overlapped a little just in front of the nasal spine and the nose was returned to its place.

The change was quite marked but it was evident that further improvement could be obtained by lengthening the columnella and inserting a bit of cartilage along the superior margin of the septum from nasal bones down to the tip.

It was not considered best to do this at once so the wound was closed and our surplus supply of cartilage was slipped under the skin of the abdomen through a small incision and thus was stored for future use. Usually we store it under the edge of the chest wound but this had been closed and covered.

The healing was by first intention. Two weeks later the second operation was done. The scar was removed where columnella joins lip and the columnella, hinging at the tip, was separated from the septum and lifted up. A tunnel was now made under the skin of the nose in the midline from tip up as far as the nasal bones and into this was slipped a piece of cartilage the shape and size of which had been determined by previous clay and cast studies. The wound was then closed and healing was uneventful.

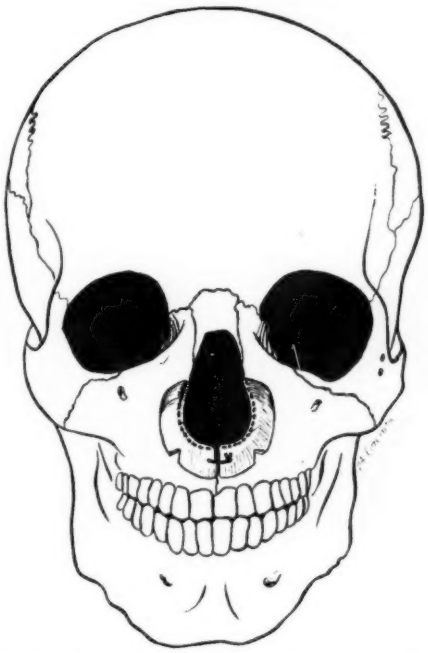

Fig. 6. The natural curve caused the pieces readily to adapt themselves to the procedure.

The change in the appearance is quite striking but the psychic change is far more marked.

The procedure is simple and seems certain and safe if care is taken not to open the nasal or oral cavity or otherwise to infect the wound.

NOTE: The photographs have not been retouched or altered in any way.

FRACTURES OF THE FEMUR—TREATMENT AND RESULTS ATTAINED BY TRACTION AND SUSPENSION

A Report of One Hundred and Ten Cases

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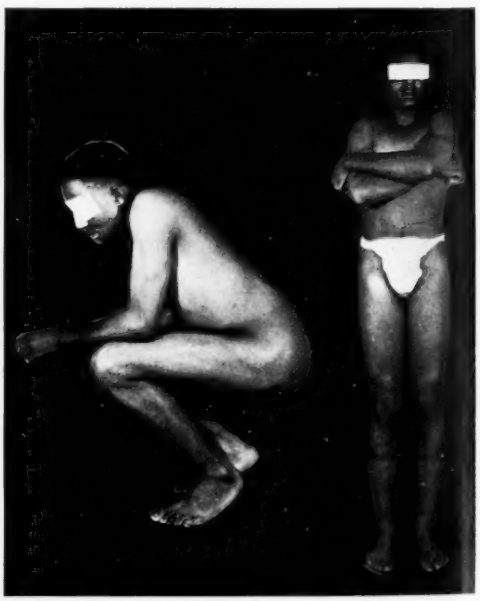
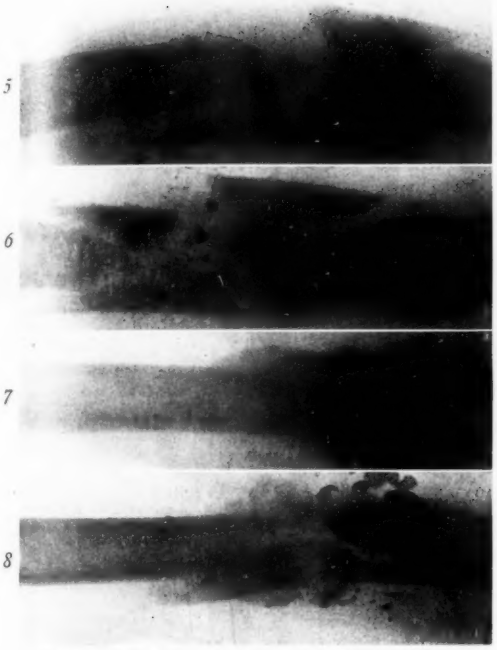
BEFORE the outbreak of the World War, there was a decided dearth of contributions to surgery on the treatment of major fractures. For 50 years or more, excluding the notable works of a few of the leading surgeons of the world, this extensive and important subject remained stationary. As the war advanced, the attention of surgeons was more and more directed to the study and treatment of fractures, with the result that many noteworthy advances have been recorded in the surgical annals of the world. There is today, however, a lamentable lack of knowledge and interest on the part of the general surgeon, and the old inclination to turn over this particular type of injury to the minor assistants or internes still persists.

Fractures demand great care and judgment on the part of the most skillful surgeons, and are, today, as important a part of surgery as other surgical specializations. Because of the compensation acts effective in many States, the increasing number of industrial works, and the innumerable accidents in the daily routine of life, it is obligatory that special care and results be attained in fractures. By so doing, patients, who would otherwise be a burden to themselves and to society, can be made useful citizens. A cripple is an expense to himself, to his employer, and to his community at large. The profession must consider his affliction as seriously as others, and it must realize that a fracture demands as immediate and proper attention as an acute abdomen. By so doing, the many thousands of deformities will be prevented.

Figs. 1 and 2. Anteroposterior and lateral roentgenographs showing results of simple transverse fracture of the left femur at the junction of middle and lower thirds. Skeletal traction and suspension used.



Figs. 3 and 4. Showing the final results of Figures 1 and 2. No disability. Excellent functional results.



Figs. 5 and 6. Anteroposterior and lateral roentgenographs showing compound comminuted fracture of the upper and middle thirds of left femur. Gunshot wound. Débridement was done. Absolutely impossible to remove all fragments of the bullet. All other foreign material removed. Suspension and skeletal traction used.

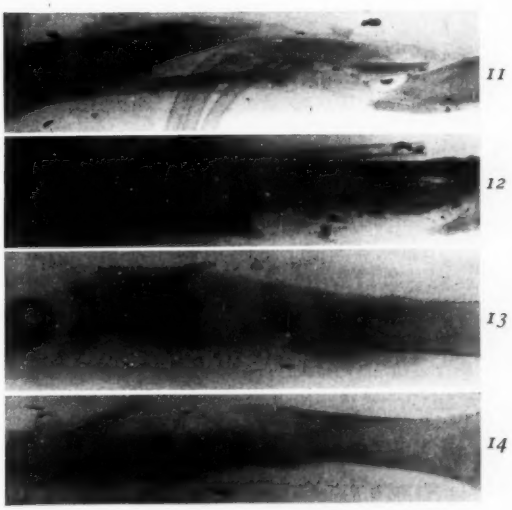
Figs. 7 and 8. Showing the same fracture as in Figures 5 and 6 twelve weeks later.

The following series of fractures is being reported to show the excellent results that have been achieved by the combination of modern methods and a few original ideas.

These fractures were treated over a period of 4 years. In 50 per cent there was severe contusion of the soft structures. Nine of the lower one-third fractures involved the knee joint. There was shortening in 11 cases. The greatest shortening in any one case was 1½ inches. All the compound fractures were comminuted. The average time for return to work, at light duty, was from 145 days to 165 days. The average time lost from full duty was from 195 days to 215 days. Sixty-seven per cent did the heaviest kind of work, and 90 per cent of these returned to the same work as before injury. Open reduction was done in 4 cases, in 2 cases it was done on account of muscle interposition and in 2 it was done because of delayed union.

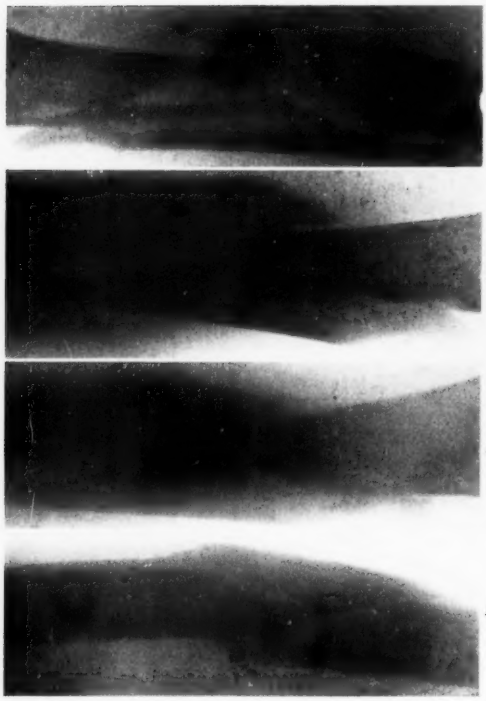
Figs. 9 and 10. Showing functional results in patient in Figures 7 and 8, fourteen weeks after injury. Final results in this case were excellent. Patient accomplished full flexion at the knee. No shortening.

Eighty per cent were treated with direct skeletal traction, caliper, with the aid of Thomas



Figs. 11 and 12. A most severe compound comminuted fracture of right femur. Gunshot wound. Treated with skeletal traction and suspension.

Figs. 13 and 14. Results obtained in case shown in Figures 11 and 12, sixteen weeks later. This patient, a boy, 14 years old, had excellent results, walking on leg within 25 weeks, without support. Accomplished full flexion and extension at knee. No shortening.

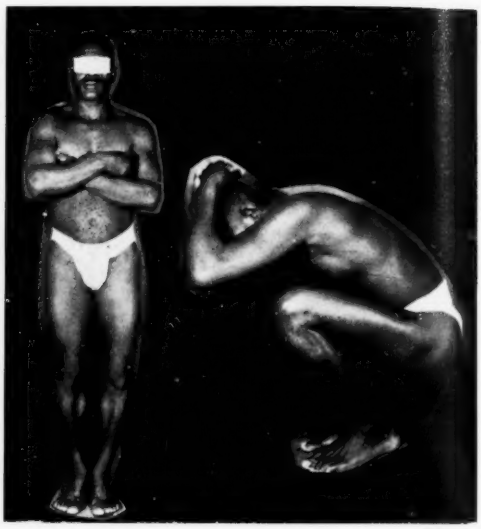


Figs. 15, 16, 17 and 18. Showing anteroposterior and lateral roentgenographs of comminuted fracture of middle and lower thirds of left femur, before and after treatment with skeletal traction and suspension.

splint, knee flexion apparatus, and the author's frame (Figs. 23, 24 and 28). The remaining 20 per cent were treated in children, where traction with adhesive was used.

Treatment with the direct skeletal traction and knee flexion makes it very easy to take frequent measurements, and to get sufficient traction, as well as excellent alignment and bone approximation. It facilitates dressings in compound fractures, makes possible daily inspections, massaging, application of diathermy and radiant light, and frequent checking with the roentgen-ray. Excellent care can be taken of the soft structures and neighboring joints, thereby producing good functional results, which is the ultimate purpose in view. The patient experiences very little pain, practically none from the caliper, and he can easily move about in bed without interfering with the position of the fragments.

The injured limb should be examined with the greatest precaution. Every unnecessary move means trauma to the surrounding structures and



Figs. 19 and 20. Showing functional results of Figures 17 and 18, 24 weeks later. No disability.

Figs. 21 and 22. Anteroposterior and lateral roentgenographs showing excellent results of a spiral fracture of upper and middle thirds of left femur. No disability in this case. Skeletal traction and suspension treatment used.

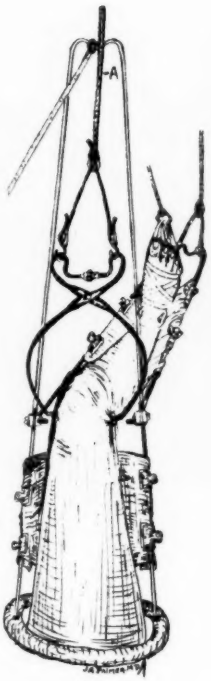


Fig. 23.

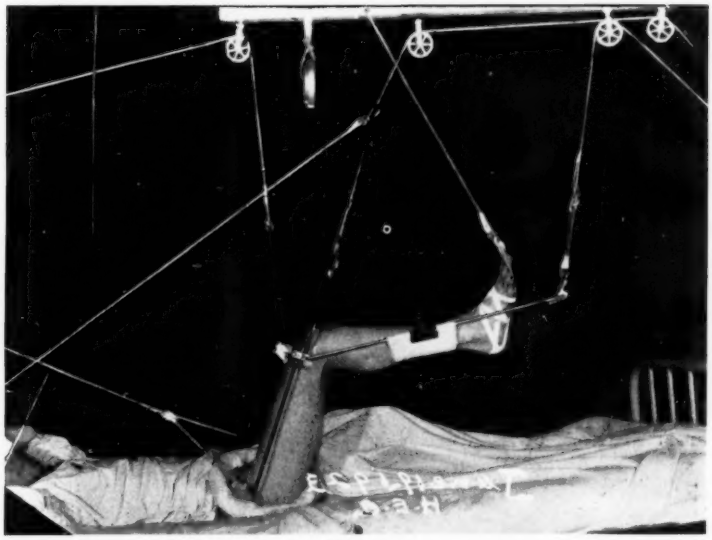


Fig. 24

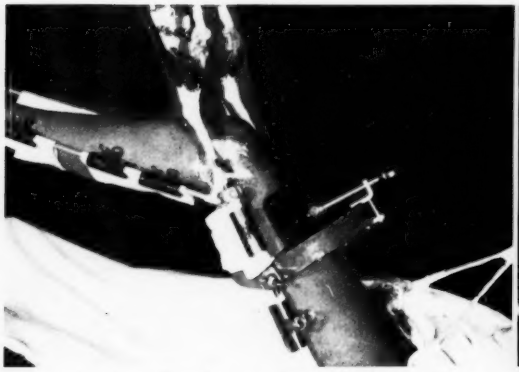
Fig. 23. Showing application of caliper, Thomas splint, knee flexion apparatus and main traction "A." The type of caliper used is similar to the Edmonton type, except the points are at a right angle when inserted in condyles of femur. This prevents a digging in of the caliper points, and if properly applied, will not slip.

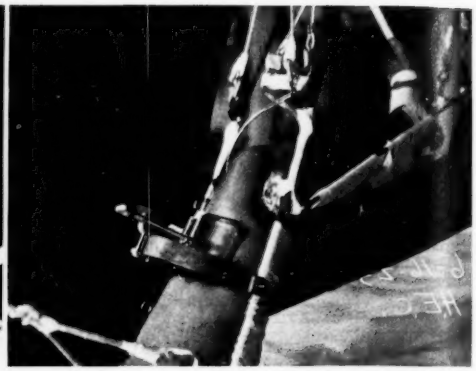
Fig. 24. Showing detail of the modified Pearson knee flexion apparatus. All the supporting muslin strips, except one, have been removed, to show detail of the leg in splint.

Fig. 25. Showing pressure pads in use.

injury to the patient. Immediate splinting and administration of all necessary procedures of the standard routine to combat shock should be carried out. The patient should be hospitalized. Anteroposterior and lateral roentgenographs should be made and very carefully studied. Every fracture is a law unto itself. The greatest consideration should always be given to the type of fracture, muscle pull, and condition of the patient. Treatment of every fractured thigh should be considered a major surgical procedure.

The frame (Fig. 28) is placed at an angle of 45 degrees over the bed. An anæsthetic should always be given, preferably nitrous oxide. Reduction is accomplished with the patient in bed. The Thomas splint, with the proper length and circumference, and knee flexion apparatus are applied to leg and thigh with careful handling. Under aseptic precaution, the caliper is inserted in the condyles of the femur according to the standard method. Proper alignment and position are obtained by applying the main traction immediately, which should be the maximum in the beginning. The amount of necessary weight depends upon the muscular development and age of the patient. For the very muscular, 15 to 25





Figs. 26 and 27. Showing two views of author's pressure pad arrangement, consisting of an iron band ¼ inch thick and 1¾ inches wide, and forming ½ circle, with a catch and thumb screw at each end to be clamped on the Thomas splint. This band can easily be applied posteriorly. The pressure pads, as shown in Figure 24, are placed at any angle necessary on the band.

pounds will be sufficient, and about 6 to 15 pounds for the younger and less muscular. This weight can easily be removed without causing the patient pain. Aseptic dressings are then applied around caliper insertions. Infection will not occur if these dressings are changed frequently. Then all the other tractions and counter tractions, and elevation of the foot of the bed on 12-inch blocks, are carried out (Fig. 29). The knee is placed at a right angle, and flexed 1 inch each day until an acute angle is reached, and then brought up by the same method until an obtuse angle is reached. Rapid motion at the knee should never be done. Serious damage may result. Daily inspections are made of the patient and the whole apparatus. Frequent checks with the portable roentgen-ray should be made. Any fragment which is difficult to keep in place can be pushed back with the aid of the author's pressure pad apparatus (Figs. 25, 26 and 27). Daily

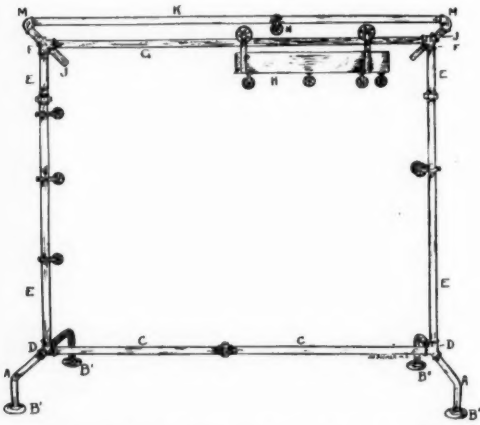


Fig. 28. Author's frame, made of 1-inch pipe. All the unions are universal. Less expensive than the wooden frame and more durable, more easily assembled and transported, as well as adjusted. The end stands "A" "A" are 8 inches high and are 33 inches long, having in the center a 4-way tee "D" "D" which connects the pipes "C," "E" and "A." The stands have a base or floor flange of four inches "B." The bottom connecting pipe "C" is 8½ feet long, having in its center a union to simplify dissembling and assembling. The ends of "C" "C" are screwed in the 4-way tee "D" "D." The end pipes "E" "E" are 6 feet 4 inches high, making the frame 7 feet high. The pipes "E" are screwed in the 4-way tees "D" "D" and "F" "F." The lower end pieces of pipes "E" "E" are 70 inches high and the upper end pieces of pipes "E" "E" are 6 inches high, each being connected by a union. The top connecting pipe "G" is 8 feet 6 inches long. On this pipe is placed the carriage "H" which is a wooden block 1½ inches thick, by 3½ inches wide, and 43 inches long. This carriage is held on pipe "G" by two iron bands, each attached to a roller, enabling the carriage to be easily pushed back and forth. Projecting at right angles on each side of the 4-way tees "F" "F" are 4 pieces of pipe, "J" "J," 12 inches long. Each one is screwed into the 4-way tees "F" "F." Pipe "K," which is 8½ feet long, is screwed in the pipes "J" "J" with aid of right and left elbows "M" "M." This is placed on the right or left side, depending on which femur is fractured, and is used for pulley "N," which receives the traction rope for the foot. This pulley can be adjusted at any point along the pipe "K." The three pulleys on pipe "E" are 2½-inch pulleys, and are placed at the head, being held permanently in place, as also the double pulley which is at the foot. The lower pulley is 26 inches from the 4-way tee "D." The middle pulley is 50 inches and the top pulley is 64 inches. Double pulleys on the foot are 50 inches from the 4-way tee "D." The rollers used on the carriage are 2½-inch screw pulleys. None of these pulleys are taken off the frame, except those on the carriage, which necessitates adjustment at times.

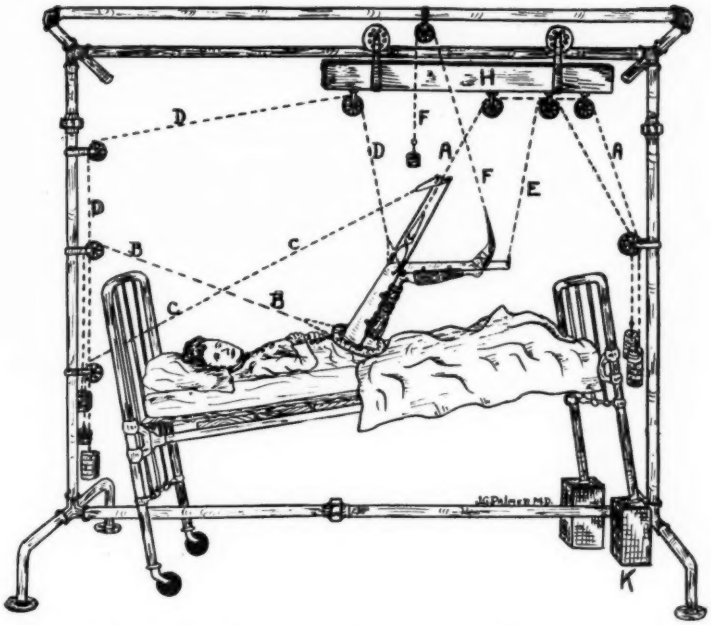


Fig. 29. Author's frame in use. Note that pull "B" and the elevation of the bed on 14-inch blocks is counter traction to pull "A." Also note that pull "D" is counter traction for pull "C." With the leg and foot held by "E" and "F," it completes a perfect suspension, enabling the patient to move about in bed without any handicap to himself or any serious damage to his fracture. The weights used are the ordinary 1-, 2-, and 3-pound scale weights, held together by an ordinary piece of crooked iron rod. The average length of Thomas splint used with this frame should not be more than 38 inches. This allows a lower frame.

massage, diathermy, and radiant light are of the utmost importance and should be given to the thigh, knee, and leg from the first few days of injury until the final discharge. Hot water baths should also be given daily as soon as the limb is removed from the splint. Rapid and abundant callus formation, excellent condition of the soft structures, normal function and earlier return to duty have been accomplished by this treatment. Diathermy must not be used in the presence of pus or very large subcutaneous or intramuscular hæmorrhage. When roentgen-rays show sufficient callus formation, an anæsthetic should be given the patient and the limb taken down and placed in supportive splints. Twenty-five to 32 days is the average time for this formation. The splints should be removed daily, and active and passive motion, hot baths, massage, diathermy, and radiant light used. As soon as there is enough callus formation to insure no malposition, all splints should be removed. With treatment as outlined, the excellent condition obtained for the

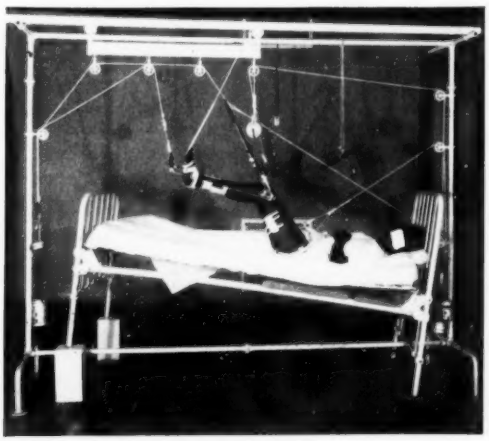


Fig. 30. Author's frame in actual use, showing treatment of simple and compound fractures.

TABLE I. CLASSIFICATION OF 110 CASES AS TO AGE AND SEX

Ages	1–5	5–15	15–25	25–35	35–45	45–55	Total
Female	1	4	1	..	1	..	7
Male	6	11	17	30	20	19	103
Total	7	15	18	30	21	19	110

TABLE II. CLASSIFICATION OF CASES AS TO TYPE

	Upper Third	Middle Third	Lower Third	Total
Oblique	7	9	2	18
Transverse	12	23	15	50
Spiral	2	3	1	6
Comminuted	6	19	11	36
	27	54	29	110
Compound	3	9	7	19
Simple	24	45	22	91
	27	54	29	110
Right	14	28	16	58
Left	13	26	13	52
	27	54	29	110

soft structures is remarkable. Because the muscles function normally and were as well developed as before injury, ambulatory splints were not necessary. Crutches were used following removal of splints until the patient was able to stand weight bearing, and this was possible on an average in 13 weeks.

With compound fractures of this series, a thorough débridement and closure of the wound under rigid aseptic precautions was done, and antitetanus serum was administered. Otherwise, the treatment was the same as for the simple fracture previously outlined. Extensive compound fractures were treated by this method and results were obtained that would have been impossible otherwise.

Open reduction was always avoided until a fair trial had been given by the direct skeletal traction. Therefore, regardless of which method is used in the open reduction of fractures, it must be acknowledged that the chances for infection in traumatized tissue are great. Union does not take place as rapidly as in simple fractures, and the wound in healing is bound to have considerable scar formation of the soft structures, thereby lessening full functional results.

Often cases are seen where open reduction was done and circular plaster casts applied, after which roentgen-ray showed excellent bone approximation, and the limb was allowed to remain in a cast several weeks. When the cast was removed, there was found an ankylosed knee, a fixed patella, a rigidity and wasting of all the muscles and other soft structures. Such a condition proves that all poor results are not the direct sequence of the injury, but are merely an interference on the part of the surgeon to help repair the damage done.

SUMMARY

1. Fractures demand great care and judgment on the part of those with competent surgical training.

2. Proper splinting, combating shock, and immediate reduction should be done.

3. All fractured femurs should be hospitalized and treated as a major surgical case.

4. Anteroposterior and lateral roentgen-rays should be made, and the type of fracture, muscle pull, and condition of patient should be very carefully studied.

5. An anæsthetic should be given in every case if the general condition permits.

6. Treatment with skeletal traction, knee flexion and suspension, with the modification of the Balkan-Blake frame was found very efficient.

7. Frequent checks with the roentgen-ray, daily treatment with radiant light, diathermy, massage, and active and passive motion should be carried out from the date of injury until final discharge.

8. The limb should be removed from the splint as soon as enough callus has formed to prevent malposition, and placed in supportive splints, which can be easily removed for daily inspection and treatment of limb.

9. All supportive splints should be removed as soon as possible, and weight bearing allowed with the aid of crutches as soon as roentgen-ray and physical examination show enough callus formation.

10. Compound fractures should have a thorough débridement, closure of the wound, administration of antitetanus serum; otherwise treatment is the same as for the simple fracture.

11. Circular plaster casts should not be applied.

12. Open reduction should always be avoided until a fair trial with skeletal traction and suspension has been carried out.

LATERAL DISPLACEMENT OF THE CORD IN OBLIQUE INGUINAL HERNIA OPERATIONS

A Modified Bassini Operation to Lessen Recurrence in Selected Cases

By LEIGH F. WATSON, M.D., Chicago

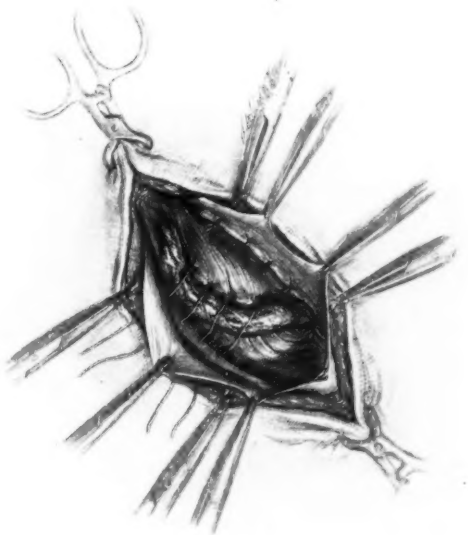
WHEN recurrence follows the operation for oblique inguinal hernia, it almost always takes place at the internal ring, at the lower end of the incision over the pubic bone, or in the line of deep sutures. In suitable cases I re-enforce these weak spots by a *lateral displacement of the cord*. The Bassini operation is followed up to the point where the cord is transplanted. The cord is made as small as possible by removing all of its coverings, leaving only the vas deferens and the spermatic vessels. The upper flap of aponeurosis is freed from the internal oblique as far as the outer border of the rectus.

The cord is placed on the internal oblique ½ to 1 inch internal to the deep suture line, the exact distance depending on the length of the cord, and retained in this position by one or two sutures. These mattress stitches are inserted external to the cord, internal to the deep suture line, and they unite the inner surface of the aponeurosis to the internal oblique and conjoined tendon. The aponeurotic flaps are overlapped in the usual manner. I often suture the aponeurosis to the deep suture line—Poupart's ligament, internal oblique and conjoined tendon—as high as the lower edge of the internal ring.

This method of closure re-enforces the internal ring by changing the angle of the cord as it leaves the ring and by getting the cord away from the deep suture line; it places a strong double breasted barrier of aponeurosis directly over the internal ring and the deep suture line; it permits firm union between the muscles and aponeurosis along the deep suture line, so that the internal ring and the line of deep stitches, the usual points of recurrence, are doubly re-enforced.

There is no danger of getting the sutures tight enough to cause pressure on the cord, in spite of the increased length of the canal, because the floor of the canal is formed entirely by the internal oblique muscle and no pressure is exerted on the cord from the inner side.

This operation can not be used when the spermatic cord is abnormally short, as in hernias associated with maldescended or undescended testes; or in recurrent hernias when the aponeurosis of the external oblique is deficient or has been replaced by scar tissue. When the internal oblique is poorly developed, the mattress stitches unite the aponeurosis to the cremaster and transversalis muscles.



I have found this operation especially valuable in treating patients suffering with recurrent oblique inguinal hernias. I have used it successfully in a number of patients who have had two to four previous operations by the ordinary methods.

THE TREATMENT OF WOUNDS IN COMPOUND FRACTURES OF LONG BONES

By FENWICK BEEKMAN, M.D., F.A.C.S., New York

RECENTLY there has been more or less discussion on the proper method of treatment of the wounds in compound fractures. There are those who, because of their war experience, believe that primary closure of the wounds can be performed in most of the cases, while others feel that all wounds should be left open. It seems that the supporters of both of these methods have lost sight of the fact that in the treatment of these wounds several factors should be taken into consideration and that no one procedure will fit all cases. The principles learned in the war for the care of wounds in compound fractures can be used to the best advantage by considering each type of case independently and treating it accordingly.

The wounds of compound fractures may be classified into two groups, dependent upon the method of their production. In the first group are those in which the wound in the soft parts and skin are caused by the fractured ends of the bone; this may be known as a compound fracture produced from "within out" (Case I). The violence producing it is usually indirect. First the bone is fractured and the force not being entirely expended, the fragments are displaced, cutting or crushing the tissues until finally the skin is perforated. Therefore, the factors determining whether a fracture of this type is to become compound are the amount of force producing the fracture, the relative sharpness of the ends of the fragments, and the direction in which they are displaced.

In compound fractures produced from within out, the ends of the fragments are usually sharp, the line of fracture oblique or spiral. However, when the fractured bone lies directly under the skin, as in the case of the tibia, a transverse fracture at times perforates the integument (Case 2). In compound fractures from within out, the bone is seldom comminuted. In producing the wound the sharp ends of the bone cut cleanly through the soft parts, leaving the tissue surrounding the tract fairly free from effects of the trauma and the wound in the skin is usually small and cleanly cut. Bleeding may be free but is mostly confined to the area of the tract, the blood escaping from the wound in the skin. The bones seldom protrude from the wound and the clothing often protects it from contamination.

The second type, the compound fracture produced from "without in," is caused by direct violence, a crushing injury as from a wheel passing over a limb, a weight falling on the part, or the penetration of a missile from an explosion. The soft parts are injured before the bone, and the injury to them is most often more serious from the standpoint of preservation of the limb than the actual fracture. The amount and type of injury to the soft parts depends upon the manner in which the injury occurred. A wheel passing over a limb (Case 3) not only crushes the part at point of contact but also rolls it, separating anatomical planes and tearing tissue. Thus the skin may be found separated for the whole circumference of the limb, both above and below the point of actual contact; muscle planes are separated and there is infiltration of blood in and between the muscles. This results in impairment of circulation wide of the actual wound.

A weight falling upon a limb crushes tissue beneath the actual point of contact (Cases 4 and 5), there is also damage done to the tissue more or less wide of this area, apparently from a bursting force produced by the compression. Therefore, at times the skin will be found to be opened some distance from the area of contact of the trauma, almost as cleanly as if produced by a sharp instrument. There is consequently tissue damage with circulatory disturbance more or less wide of the actual wound.

Compound fractures produced by penetration of missiles, result in wounds similar to those seen in war time. The wound of entrance is punched out and the walls of the tract are contused and lacerated. The bone is usually comminuted and the bone fragments, often becoming secondary missiles, further destroy and injure tissue.

The conditions under which fractures of this type (i. e. fractures from "without in") occur, are usually such that gross contamination of the wound is certain. In accidents in which the part is rolled or crushed, infection is ground into the superficial tissue (Cases 3, 4, and 5), while in those in which there is a penetration of foreign bodies, the infection is carried deep into the tissue by the missile. The conditions present are ideal for bacterial growth. The resistance of the tissues is lowered because of the injury to them and the interference to their blood supply, and the exu-

Fig. 1. Compound fracture produced from within out, of the lower end of the tibia and fibula of the right leg. Case 2.

Fig. 2. Compound fracture of the tibia of the right leg produced by a crushing injury. Case 4.

dates are ideal media; consequently infection will soon spread between the disorganized planes or into the muscles themselves, finally reaching the exposed ends of the bone.

Treatment of compound fractures should aim to eliminate such contamination as has already taken place, and to prevent the spread of infection. In most compound fractures, the infection at first is on the surface of the wound. This is almost always the case except where there has been a penetration of some type of missile which carries infection before it or where an end of a bone which has become contaminated is replaced before it has been properly cleansed (Case 2), carrying infection in with it.

As contused tissues are apt to be contaminated and also present all the conditions proper for bacterial growth, they should be removed, if possible. Likewise dead spaces, between planes of tissue, should be prevented, for exudates gather in them, which at first may be sterile but soon become infected.

The conditions present in these two types of compound fractures are quite different. In those wounds produced from within out, local resistance to infection is not materially decreased, and gross contamination is seldom present. In the type produced from without in, local resistance of the part is lowered and the tissues are diffusely contaminated.

Treatment is begun as soon after the accident as possible. In the simpler cases when there has been a small break in the skin, as is found most often in a compound fracture from within out (Case 1), all that may be needed is a sterilization of the skin with tincture of iodine, a sterile dress-

ing, and a properly applied splint or suspension with traction. It is important not to do any more manipulation than is necessary to get the bones in proper alinement so as to prevent further damage and spread of infection. These cases will almost always heal by primary union of the soft parts with union in the fracture as in a case of simple break.

In the case of compound fractures where the wound is large with more or less destruction of tissue, and possible contamination as is so often found in fractures from without in, the following procedure has been carried out with success. As soon as the primary shock allows, the patient is given a general anæsthetic. The skin about the wound is carefully scrubbed with a sterile nail brush, using green soap followed with sterile water. Then the wound is cleansed by scrubbing it with gauze, using soap, followed by irrigation with sterile water and the surrounding skin is painted with a 5 per cent alcoholic solution of picric acid. The part is now draped. All contused skin edges are carefully excised with a sharp knife. Where the skin is separated from the underlying planes, it is freely incised, opening pockets which later may cause dead spaces in which exudates might gather. The débridement is then carried to the surface of the wound from which all contused tissue is removed together with any fascia that might be contaminated. The deeper parts are not disturbed and bone fragments are not removed unless they are detached and lying on the surface. The wound is then thoroughly flushed with ether. Traction is now applied to the limb. This has previously been attached and may be skin traction, Steinmann nail, tongs or any other type that is appropriate for the individual case. Traction eliminates dead spaces between tissue planes by keeping the muscles taut and bringing them in closer contact. The skin about the wound is now protected with vaseline gauze and the surface of the wound is covered with Carrel-Dakin tubes which are temporarily held in place with a layer of gauze, wet with Dakin's solution. This is covered with proper dressings and the limb is suspended in a wire splint of the Thomas type with weight traction applied. The tubes are irrigated with Dakin's solution every 2 hours. In a few days the spaces between tissue planes should become sealed, and if the fractured surfaces have been entirely covered with soft parts they will heal as rapidly as a simple fracture. When healthy granulations have formed upon the surface and all infection is eliminated, skin grafts may be applied to hasten the epithelization of the wound.

No manipulation to improve position of the fragments should be made after the original operation as such movements may open up planes of tissue that have already commenced to heal.

In wounds resulting from the penetration of a missile, the entire surface of the tract is possibly infected from the contamination carried in by the foreign body. These cases are treated similarly to those which we have just described with the exception that the débridement is to be carried much deeper into the wound, the foreign body has to be removed and the cavity leading down to the fracture caused by the débridement must be properly Dakinized.

In fractures from within out, in which the ends of the bones have become contaminated (Case 2), reduction must not be attempted until the ends have been cleansed by removing such portions of the bone as may be contaminated. If this is properly done, the soft parts can be closed over the fragments, allowing them to heal as in a simple fracture.

CASE 1. B. K. A boy 5½ years of age was admitted to the Lincoln Hospital on May 17, 1923. Just before admission he was struck by an automobile, which did not pass over him. He was brought to the hospital in a drowsy condition. There were abrasions of the forehead and ecchymosis about both eyes. There was a fracture of both bones of the right leg and a small punctured wound of the skin just over the line of fracture. X-ray showed an oblique fracture at the junction of the middle and lower thirds of the tibia and fibula with good position of the fragments. The skin about the wound was painted with iodine and a dry dressing applied; the leg being placed in molded posterior and lateral plaster splints. In 12 days patient was up on crutches and was discharged on the fourteenth day with firm union present.

CASE 2. L. F. A boy 13 years of age was admitted to the Lincoln Hospital on December 11, 1923. Just before admission he had jumped off a roof 10 feet to the ground. He slipped and fell into a ditch, landing on the lateral side of his right foot. He heard something snap in his right leg and it doubled up under him.

On admission there was a large, gaping, lacerated wound on the mesial aspect of the right leg, about 3 inches long, from which protruded about 2 inches of the lower end of the upper fragment of the tibia. The fibula could be seen to be broken at the same level as the tibia.

He was given gas ether anæsthesia, the skin of the leg was thoroughly cleansed with soap and water and shaved. The wound was then cleansed in the same manner and the entire skin surface of the foot and leg was painted with a 5 per cent alcoholic solution of picric acid. A Steinmann nail was passed through the heel just above the os calcis. The surface of the wound and skin edges were carefully débrided and the protruding end of the upper fragment was carefully cleansed by removing its surface with a rongeur. The fragments were then reduced and traction applied through the Steinmann nail. The surface of the wound was covered with Dakin tubes and dressing applied. The leg was suspended in a Thomas hip splint with traction.

Nine days after the accident the wound was clean. There was about 2 square inches of the surface of the tibia,

including the line of fracture, exposed. Dakin's was discontinued and dichloramine-T dressing applied. On January 1, 1924, 20 days after the injury, there was firm union. The Steinmann nail was removed and posterior and lateral molded splints applied. On January 20 the splints were removed and 4 days later patient was up on crutches.

In the meanwhile, granulations had covered the entire surface of the exposed bone.

CASE 3. J. E. M. A boy 6 years of age was admitted to the Lincoln Hospital on the morning of July 20, 1923. Just before admission he was struck by an automobile, a wheel of which passed over his left thigh. On admission he was conscious.

On the flexor surface of the lower third of the left thigh there was a wound, triangular in shape, which measured about 4 by 3 inches. It communicated with the femur which was fractured at its middle third. The muscles were very much contused and portions were lacerated. The skin edges were bruised and the surface about the wound was very dirty. There was also ecchymosis in the pubic region and compression of the pelvis caused pain.

Soon after admission he was taken to the operating room and given a general anæsthetic of ether. The skin of the whole leg, from the toes to the hip, was scrubbed with green soap and water. The wound was then thoroughly cleansed with soap and water and the surrounding skin painted with a 5 per cent alcoholic solution of picric acid. A Steinmann nail was passed through the heel just above the os calcis and traction exerted. The skin edges of the wound were débrided and the fascia and lacerated muscles on the surface of the wound were carefully excised. A 3-inch counter incision was then made in the skin on the extensor surface of the thigh, the skin of which had become separated from the underlying tissues. The wound was thoroughly flushed out with ether, and the surfaces of both wounds were covered with Dakin tubes and the leg suspended in a Thomas splint by means of a Balkan frame, with 15 pounds of traction. An X-ray taken the following day showed a fracture through both pubic rami of both bones and a transverse fracture through the middle of the left femur. The lower fragment was displaced posteriorly with slight overriding.

The convalescence was uneventful. The temperature was never over 100 degrees. A week after admission the wounds were clean and the weight on the traction was reduced to 7 pounds. Thirty-two days after admission traction was discontinued, and the Steinmann nail was removed; there was no infection in the nail wound and there was firm union of the fracture. The wound was covered with healthy granulations. A molded plaster splint was applied. Thirty-nine days after admission the anterior wound was entirely healed and on the fifty-fifth day after the accident the patient was up on crutches.

On September 28 the wound on the flexor surface was grafted with Thiersch grafts, all of which took and the wound was entirely healed on October 23 and the patient discharged. Since then he has given up his crutches, there is full range of motion in the knee joint, and only one-fourth inch shortening of the leg.

CASE 4. A. K. A man 26 years of age was admitted to the Lincoln Hospital on October 21, 1922; his occupation was chaffeur. Shortly before admission the patient had his right leg, just below the knee, crushed between the fenders of two automobiles. He was in extreme shock. The upper third of the right leg was crushed for the distance of 4 inches, and the skin was separated from the underlying tissue for the extent of three-quarters of the circumference. All the muscles appeared to be contused and lacerated and several fragments of bone were on the surface of the wound.

Fig. 3. Compound fracture of the bones of the forearm. Case 5.

The patient was taken immediately to the operating room and given a general anæsthetic of ether. His right leg was thoroughly scrubbed with green soap and water, shaved, and the skin painted with a 5 per cent alcoholic solution of picric acid. Tongs were applied to the malleoli and traction started immediately. All muscles were found to be crushed and much contused. The skin was undermined at its edges for a distance of several inches. The bone was comminuted into many small fragments, and there appeared to be a loss of continuity for about 1½ inches of the shafts of the tibia. The skin edges were carefully excised, a few detached fragments of bone on the surface were removed and portions of contused and lacerated muscles on the surface of the wound were excised. Counter incisions were made in the undermined skin. The wound was flushed out with ether and all the exposed surfaces of the wounds were covered with Dakin tubes. The leg was suspended in a Thomas splint by means of a Balkan frame and 15 pounds traction was placed on the tongs. It was impossible to obtain an X-ray until 25 days after admission of the patient, which showed a comminuted fracture of the upper third of the right tibia. A large bone defect was present at this site and a large free fragment of bone.

Convalescence was uneventful, temperature never rose above 100 degrees, and the wound remained entirely clean.

Forty days after admission the tongs were removed, and there appeared to be some fibrous union present in the fracture. The wound at this time had healed flush to the skin except for a small bony cavity in the tibia. The leg was placed in a molded splint.

On discharge, March 23, 1923, 161 days after admission, the patient was walking about in a Thomas ambulatory knee splint. False motion was still present in the fracture and the wound had contracted to about 1 inch in diameter and was represented as a flat ulcer with bare bone of the tibia as its base. On October 15 there was firm bony union present, and the splint was discarded. There was flexion of 105 degrees in the knee at this time.

CASE 5. G. L. A man 58 years of age, dock builder by occupation, was admitted to the Lincoln Hospital on December 12, 1923. Shortly before admission he had had his right forearm crushed between a pile driver and the dock upon which he was working. The patient was in moderate shock.

In the middle of the right forearm there were compound, comminuted fractures of both the radius and ulnar. There were two skin wounds on the flexor surface of the forearm, one on the radial side, and the other on the ulnar. These measured about 4 inches in length. The skin between them was entirely undermined. The flexor and supinator muscles were crushed and very much contused and lacerated and all the planes between them were separated.

Soon after admission the patient was taken to the operating room and given a general anæsthetic. The skin about the wound was thoroughly scrubbed with soap and water and shaved. The wound was cleansed with soap and water and the skin was painted with a 5 per cent alcoholic solution of picric acid. The skin edges were carefully débrided. The bridge of undermined skin between the two openings was divided, and superficial portions of the crushed muscles were excised. The bone fragments were then placed so that they were entirely covered by soft parts and the wound thoroughly irrigated with ether. The wound surface was covered with Dakin tubes and dressed with gauze. The arm was suspended in a Thomas arm splint with 5 pounds of traction by means of a cotton glove which was glued with celluloid glue to the hand.

Six days after operation the following note was made: "Wound is clean, deeper planes are all healed." The Carrel-Dakin treatment was discontinued and the wound thereafter dressed with dichloramine-T. January 8, 27 days after admission, the wound was grafted with Thiersch grafts and a week later it was found that they had all taken. On January 29, 48 days after admission, the forearm was put up in a molded splint. On discharge, February 2, 1924, wound was entirely healed, with firm union in ulnar, but slight false motion in radius at site of fracture.

SUMMARY AND CONCLUSION

1. The wounds of compound fractures can be roughly divided into two groups, those produced from within out and those from without in.

2. Wounds produced from without in are more apt to be contaminated, and the damage to the various tissues is greater than those produced from within out. Consequently, there is greater possibility of infection following such a wound.

3. No standard type of treatment can be used for the wounds of all compound fractures.

4. The indications for treatment of compound fractures are reduction of the fragments with as little trauma as possible, removal of contaminated and devitalized tissue, the elimination of dead space and the prevention of infection spreading into the wound from the surface.

5. In the simpler types, cleansing of the skin, sterile dressing and immobilization is sufficient. In those with more severe wounds, the above conditions can be brought about best by immediate reduction of the fracture, thorough cleansing and débridement of the wound, obliteration of dead space by means of traction and prevention of surface infection by Carrel-Dakin treatment.

6. In those cases in which infection has been prevented and in which it has been possible to cover the bone with soft parts, union at times takes place as in simple fractures.

A NEW TRACTION FRAME AND CALIPER FOR FRACTURED FEMURS

By MITCHELL LANGWORTHY, M.D., Spokane, Washington

SKELETAL traction, in the treatment of fractures of the femur, deserves a wider recognition, and more general application than it receives. I believe that the many time-consuming details and mechanical and practical difficulties associated with its employment are the real reasons for its infrequent use. It is the purpose of this article to describe the apparatus by means of which I have overcome some of these difficulties, and through which the method has become a pleasure instead of a nuisance for me.

This article is not intended as an argument for the method. There is sufficient literature easily available to anyone unacquainted with, or unconvinced of its value. Nevertheless, I cannot forego the opportunity to enumerate the outstanding advantages of the skeletal traction method for fractures of the femur. These are (1) prevention of shortening and deformity; (2) prevention of knee and hip joint stiffness; (3) prevention of atrophy of thigh and leg muscles.

I am not asserting, of course, that the method will prevent 100 per cent of all the difficulties that arise in connection with femur fractures, but I do believe that, with this method, we can more closely approximate both the anatomical and physiological requirements than with any other present method of treatment. In speaking of skeletal traction as a method, I am presupposing that, in addition to the direct extension on the bone, the method will include the support of the limb in the position best calculated to overcome noxious muscle pull. Further, that the physiotherapy, which the method so well provides for, will be properly carried out. I am convinced that the more generally this method is taken up as a routine procedure, the less frequently will open operation be necessary for reduction of these fractures. In addition, I am confident that, efficiently carried out, skeletal traction will show better and quicker end-results than open operation, followed by the usual postoperative treatment; provided, of course, that function be considered at least as important as anatomical reduction.

THE PURPOSE OF THE APPARATUS

The apparatus is designed to replace the bulky and immovable Balkan frame, which we all used during the war, and have not used as often as we should since. The arrangement of the patient, with the splints and traction devices, weights and counterweights, ropes, and pulleys in the Balkan frame, has always been time-consuming and tiresome. This is especially so since, in private practice, we do not have the capable and well trained sergeants and orderlies of war days. A goodly part of a morning can be consumed in getting things rigged up properly. In addition, almost constant supervision, with daily adjustments and repairs, is required. It is not worth while to go further into these inconveniences, which are so well known by those who have been through the experience.

At the start, let me state, that I am contributing nothing new to the principles of the treatment. If there is anything original presented, it is in the nature, simply, of mechanical design and detail. We have had, as far as I know, no available apparatus in which these have been thoroughly worked out.

DESCRIPTION OF APPARATUS

The apparatus forms a composite unit, which is complete in itself. There are just so many parts, and, with these, everything that needs to be done, can be done. It is always ready and complete at once for the next patient, even though an entirely different arrangement is necessary, because of a different type of fracture. The patient can be moved about from place to place, and the ordinary needs of the bed-fast patient can be attended to, without disturbing, in any way, the relation of the patient to the traction and supporting mechanism. He can be taken to the surgery or the X-ray department, or to a porch for fresh air and sunshine. The mechanical details of the apparatus are so convenient and complete that the entire initial arrangement of the patient, with the traction and the supporting splints, can be made in 30 minutes, and so positive that no subsequent alterations, repairs, or adjustments are necessary.

For description, I shall divide the apparatus into three parts: the traction frame, the splints, and the extension device.

The traction frame. This consists, first, of a rectangular iron-pipe frame, 6½ feet long and 2

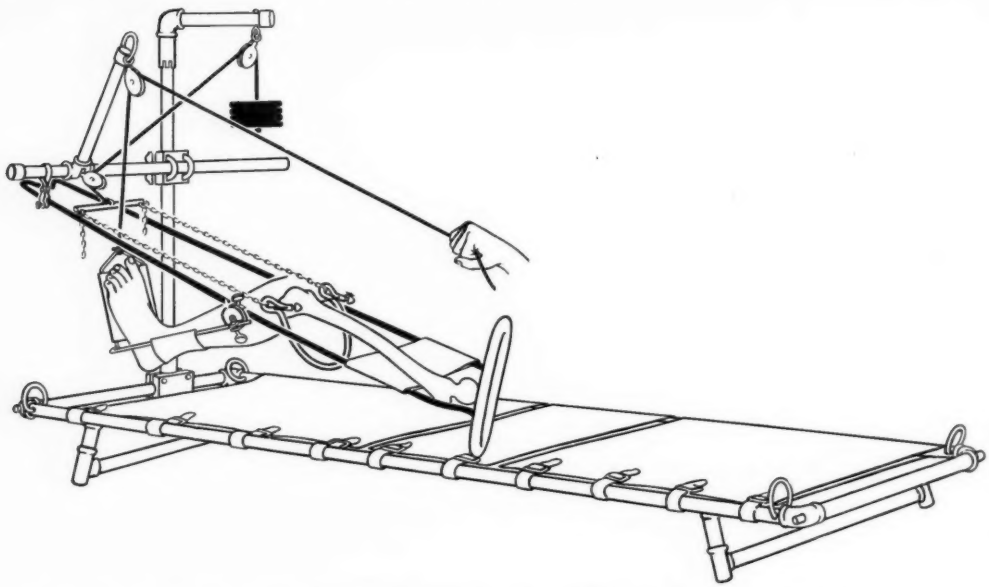


Fig. 1. The Langworthy traction frame, and caliper, for fractures of the femur. Three canvas slings across the frame support the patient. The frame is shown raised on its short legs. These lift it about 6 inches off the bed, and, by removing the narrow canvas sling, the bed-pan is easily used. At other times, the frame, with the legs folded under, lies flat on the ordinary bed mattress. A special fracture bed is not needed. The support of the limb in the Thomas splint, and in the leg and foot splint, is clearly shown. In this diagram, the thigh is midway between abduction and adduction, and both hip and knee are moderately flexed. This position is the usual one for fractures in the middle third. The arrangement of the new caliper, with its chains, and crossbar, to which the extension weight is attached, is evident. The convenient arrangement and permanent nature of the pulleys and clamps, should be noted. By the proper placing of the vertical post, which clamps to the frame, and of the horizontal bar, which clamps to the vertical post, the limb can be held in any desired position. It will then be found that the pulleys and clamps are always in the correct positions for completing the arrangement. The most important feature is that the patient and the apparatus form a single unit, which can be lifted about, placed on a stretcher, and moved anywhere, without disturbing the relations between the patient and any part of the apparatus.

feet wide. Across its width are stretched three pieces of canvas, which fasten on one side with webbing straps and buckles. Eight inches from each end of this frame is attached a short pair of legs. Ordinarily, these legs are folded under the frame, so that the frame lies flat on the bed. Its size allows it to be placed on the ordinary hospital bed. No special fracture bed is necessary. The patient lies on the canvas slings, directly on the ordinary bed mattress. When the bed-pan is used, the nurse lifts one end of the frame off the bed. This allows the short legs at that end of the frame to spring into position. The other end is then lifted, in the same way, and the frame then rests on the legs, the patient being supported on the canvas slings, about six inches above the mattress. The middle canvas, which is 9 inches wide, is then unbuckled and removed. The bed-pan is slipped under the patient, who, meantime, is supported on the upper and lower canvas slings. The pan is removed, the narrow canvas replaced, and the frame lowered by folding the legs under at each end.

The splints and extension device are supported by a vertical post 33 inches high, and a horizontal bar 31 inches wide. The vertical post is fastened to the frame, at any point desired, by a simple clamp. The horizontal bar is fastened to the vertical post, at any desired height or position, by another clamp. Two small clamps, which fasten to the end of the Thomas splint, and three pulleys, which carry the ropes for the extension weight, and the hinged leg and foot piece, are permanently attached to the post and bar, so that they are always in the correct position. A further lengthy description of these parts is useless, since they will be understood at a glance from the diagrams and photographs. With the ap-

paratus once arranged, the frame, the patient, the splints, and extension device, form a single unit, which can be lifted out of bed, placed on a stretcher, moved to the operating table, or X-ray table, without disturbing the relations between the various parts. Once arranged, every part will stay in position. Nothing is tied on with bandages, or stuck on with adhesive. Everything is permanently attached, until such time as the several clamps are unscrewed for the purpose of taking the patient out of the apparatus.

The splints. The ordinary stock Thomas splint is used. The ring does not need to be fitted or kept lifted up against the tuberosity of the ischium, since it is not used for counter pressure. The splint is used for supporting purposes only. With skeletal traction, the weight necessary for extension rarely exceeds 20 pounds, and the body weight of the patient is adequate counter-weight. If the patient is pulled down against the ring, this can be prevented by elevating the foot of the bed 6 or 8 inches. The lower end of the Thomas splint is fastened to the horizontal bar by two small clamps. These allow a little movement of the splint toward the head or foot of the frame, but the splint cannot move lengthwise beyond these limits. The thigh, only, is supported in the Thomas splint.

Another bent rod splint supports the leg and foot. This is attached opposite the knee to the Thomas splint by two double clamps. With these clamps, the length of the leg and foot piece can be regulated, and it can be attached anywhere along the Thomas splint, so that the thigh length and leg length of any patient can be fitted. The double clamp is made of two discs, which revolve on each other, allowing steady flexion and extension of the knee. The leg and foot splint is held in any degree of flexion or extension, and movements of the knee joint produced by the rope which passes from the end of the foot piece over a permanent pulley, and is then held in the hand of the patient, or tied to the ring, or to any convenient place on the frame.

The extension device. Through-and-through metal pins, such as the Steinmann, or one of the various ice-tong devices or calipers can be used in applying extension directly to the lower fragment of the femur. Some surgeons favor one, some the other. To me it has always seemed that the advantages of either one over the other were academic. It is well to note here, however, that the actual ice-tong principle is no longer used. In the ordinary ice tong, the points press in harder as more pull is put on the handle. The ice-tong or caliper devices which are sold now, are all fitted with a lock nut or screw, which fixes the depth to which the points may penetrate the bone. If these points are applied in exactly the correct place, it is necessary that they penetrate but slightly into the bone. If they are used with this idea in view, but not placed just right, they may slip. And it is not always as simple as it seems to locate them exactly where desired. It is certain that a long pin, forced entirely through the bone, will not slip. It is possible that slipping of a caliper may do no harm, but for several obvious reasons, it is not exactly desirable. If a caliper is to be the instrument of choice, it must be applied so it will not slip.

Fig. 2. The Langworthy caliper, for skeletal traction, is designed so that the knee joint can be completely extended while traction is being applied to the femur. The two pins, through which the extension force is applied, can be tapped into the bone to any depth desired. They are fastened in place by two thumb screws. The curved bar, which holds the pins, passes posterior to the thigh. The pull is applied through two chains, which fasten to the metal loops at each side of the knee. The chains pass down to a crossbar, which is beyond the foot when the knee is completely extended. The weights are attached to this crossbar. Thus, no part of the caliper is in front of the knee joint, leg, or foot, to interfere with extension.

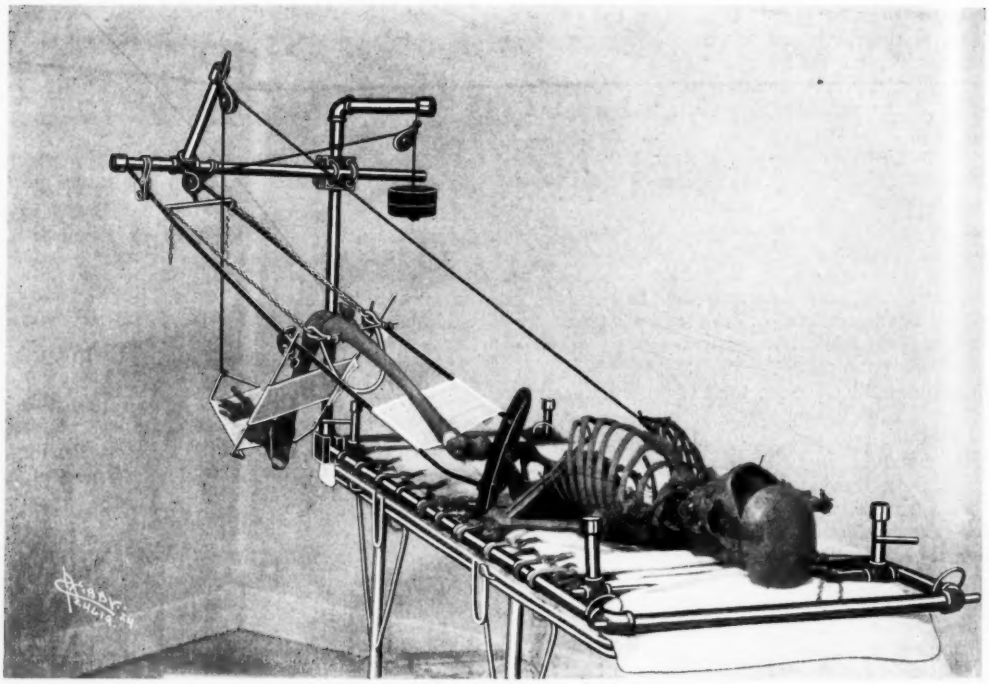


Fig. 3. The apparatus is arranged on the skeleton to show the position of wide abduction of the thigh, with a 45 degree flexion of the hip joint, and a 90 degree flexion of the knee joint. Wide abduction of the thigh is needed, many times, in upper third fractures. Marked flexion of the knee is often required for lower third fractures. It will be noted that the vertical post has been moved over, and clamped to the left side of the frame. The horizontal bar has been slid to the left, and clamped on the vertical post, so that the splints are supported in considerable abduction. This can be still further increased, if desired. The arrangement of the caliper, with its chains, is shown. There is nothing to interfere with complete flexion of the knee. The rope and pulley, with which knee-joint movements are produced, should be noted. The legs of the frame are folded under, and the frame lies flat on the stretcher. Most of the time, of course, it lies on the mattress of the bed.

There is an objection, however, common to both the through-and-through pin and the caliper devices, as they are now made. When any one of them is applied, and the extension weight attached, the knee joint cannot be completely extended. This is due to the fact that, when the knee is extended, the anterior border of the leg bumps into the caliper, where it crosses in front of the knee joint. (The corresponding part on the Steinmann pin device interferes in the same way.) This occurs when the knee is about 15 degrees from complete extension. This last 15 degrees of extension, therefore, cannot be utilized when passive and active movements of the knee are being carried out during the treatment. It is a well known fact that a lack of the last few degrees of extension of the knee, constitutes a decided disability. It is true that this can usually be obtained after the traction device is removed, by exercise and stretching, but it is certainly desirable to be able to obtain complete extension of the knee joint while the traction is being applied to the femur.

A new caliper. I have, therefore, devised a caliper which allows complete extension of the knee at all times. No part of it comes in front of the knee joint. The curved portion holding the two metal pins, which insert into the bone, passes underneath the thigh. The extension force is carried by two chains, attached to the caliper at each side of the knee, to a crossbar a little beyond the foot. In applying my caliper to the bone, it can be used as a non-penetrating (meaning only slightly penetrating), ice-tong, such as is strongly advised by some authorities. Or the pins can be tapped into the bone to any depth

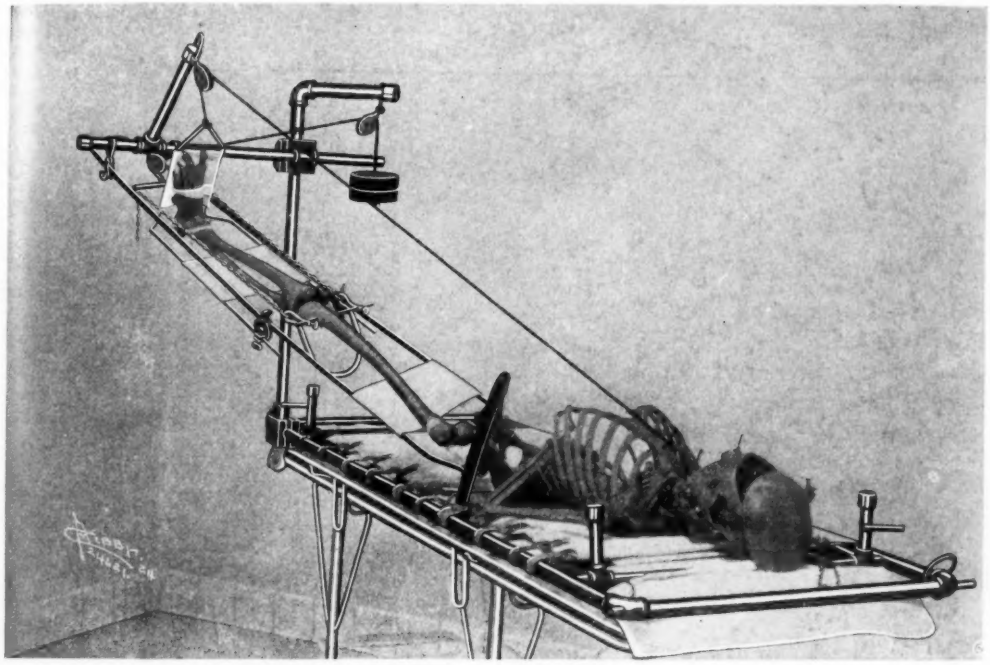


Fig. 4. The position of the limb, here, is the same as in Figure 3, except that this shows the knee joint completely extended. Observe that the entire foot and leg has been pulled up between the caliper chains. The main purpose of my caliper is to allow this complete knee-joint extension. This photograph, and Figure 3, demonstrate how the entire function of the knee joint can be maintained. It will also be understood from this picture how movements of the hip joint, as discussed in the text, are produced. These are begun after the caliper is removed. The foot end of the Thomas splint is unfastened from the horizontal bar. It is then lowered, and swung from this bar with straps. Now, note that the leg part of the leg and foot splint is wider than the Thomas splint. Because of this, a pull on the rope which connects with the foot piece, first extends the knee, and a further pull lifts the Thomas splint, thus moving the hip joint. The range of this movement is increased by gradually letting the end of the Thomas splint down from the horizontal bar.

necessary for a firm hold, or until they meet in the middle of the bone, in which case the device will not differ materially from a through-and-through pin. The important thing, surely, is to insert the points so that a firm hold is secured. If this can be obtained with only slight penetration, well and good. If not, then they should certainly be inserted far enough so that they do take a firm hold. My caliper is designed so that the pins can be easily set to any depth desired. This is a convenient arrangement, but the main advantage of the instrument is that it in no way interferes with complete function of the knee joint.

TECHNIQUE

A study of the roentgenographs will indicate whether or not skeletal traction is to be used. It has been advised especially for those fractures of the lower third of the femur where there is a backward tilting of the lower fragment. I see no reason for limiting it to this type, since I have found it equally efficient in fractures of the middle and upper third, and those through the trochanters. Reduction of the fracture can be accomplished equally well in all of these types, and the added advantage of prevention of joint stiffness and muscle atrophy, which the method affords, is equally desirable in all.

From the roentgenographs, and from a knowledge of the muscle attachments and pulls on the fragments, it is decided in what position the limb shall be placed; in other words, in what position the extension force will be most effective in securing reduction.

Use of traction frame and splints. The traction frame is then placed on a stretcher, and the

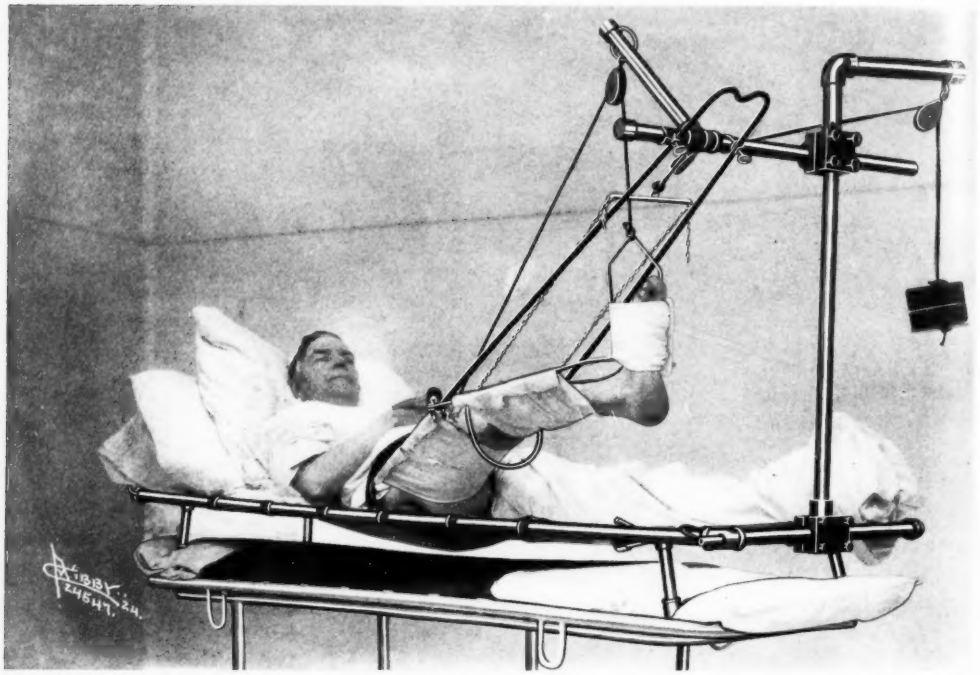


Fig. 5 This view, with a patient on the apparatus, and from a different angle, brings out many of the details more clearly; namely, the support of the patient above the mattress for use of the bed pan, the clamps which hold the end of the Thomas splint, the clamps which fasten the vertical post and the horizontal bar, the bandage slings, which hold the thigh, leg, and foot in the splints, and the suspension of the weights over the opposite side of the frame from the splints, by the adjustment of the right angle bar at the top of the vertical post. This bar revolves on the vertical post, and can be set so that the weights will hang where they will help to balance the entire apparatus, and where they will be out of the way.

patient is moved from his bed, or possibly from the X-ray table, on to the frame, and wheeled to the operating room. General anæsthesia is then produced, since a considerable reduction may be accomplished while the muscles are completely relaxed. If it is contra-indicated, the procedure is carried out in the same way, without anæsthesia, except a local infiltration with a small quantity of novocain solution for the insertion of the caliper. The limb is then slipped into the Thomas splint, and, together with the splint, is placed in the position determined upon. It is held in this position by a nurse. The leg and foot splint is then fitted on to the Thomas splint with the double clamps, so that it is the right length for the leg with the foot at a right angle, and so that the double clamps are opposite to the knee joint. Slings made of wide muslin or flannel bandages are then pinned, in the usual way, from one side to the other of the splints, to support the thigh and leg. The nurse continues to hold the splints in the desired position. The next step is to arrange the vertical post and the horizontal bar for the support of the Thomas splint. First, the vertical post is clamped to the frame. Then the horizontal bar is clamped to the vertical post, both being so placed that the two small clamps near the end of the horizontal bar come directly over the end of the Thomas splint. These clamps are then fastened on to the rods of the Thomas splint, which need be held by the nurse no longer. The leg and foot splint, however, must still be supported. The short post, projecting from the horizontal bar, is tilted upward until the pulley on its end comes into the right position for carrying the rope from the foot and leg splint. This rope is then passed over the pulley, and the foot and leg allowed to drop, and the knee joint to bend into the pre-determined degree of flexion. The limb is now entirely supported by the apparatus.

Inserting the calipers. The skin, where the caliper is to be inserted, is thoroughly cleansed and prepared. The skin on each side is then stretched toward the hip, and one-inch long incisions are made over the line of the femur, just above the condyles. The caliper is then passed up from beneath the thigh, and the points of the two pins pushed into the incisions, down to the bone. It is desirable to locate the points midway between the anterior and posterior borders of the femur, and at the point longitudinally just where the femur begins to widen out into the condyles. The ends of the pins are then tapped a little to fix them firmly in the cortex. The thumb screws, which fasten them in the caliper, are tightened. Sterile dressings are wrapped around the pins to cover the wounds. The strictest asepsis must be observed while inserting the pins. The chains from each side of the caliper are then pulled down toward the end of the Thomas splint, and the crossbar hooked into the chains far enough away from the knee so that the foot can pass up between the chains when the knee is extended. The rope from the weights is then passed through the pulley at the end of the right angle bar, which projects from the top of the vertical post, and then over a second pulley located on the horizontal bar. This pulley will be found to lie midway between the rods of the Thomas splint. From it the weight rope passes to the crossbar, transmitting the pull to the caliper chains. The right angle bar, from which the weights hang, is made so that it can be revolved on the vertical post, and it should now be placed so that the weights hang in the best position for balancing the frame, and in a position where they will not be bumped into. The length of the rope should be regulated so that the weights will swing high enough to be out of the way of the bed clothes.

It is well, at this point, to make sure that the caliper is firmly fixed in the femur by pulling directly on the chains.

Here, also, it may be noted that, since the extension force has been applied, the thigh has lengthened, and that the double clamps which connect the foot and leg splint with the Thomas splint, are no longer opposite the knee joint. The thumb screws should then be loosened, and the clamps slid down on the Thomas splint rods until opposite the line of the knee joint, and then re-fastened. The arrangement is then completed by placing a wide bandage entirely around the thigh, and around the leg, including the splints, in order to prevent the limb from being lifted out of the splints during any acrobatics the patient may indulge in while coming out of the anæsthetic.

Pain from the calipers. Complaint of pain is usual during the first 24 hours. Sedatives should be given in ample dosage to keep the patient perfectly comfortable. Restlessness and irritability have their effect in preventing relaxation of the thigh muscles. After this period, the patients are usually free from pain. Surgeons who have not used the method invariably express astonishment when it is proved to them, by actual observation, that the calipers do not produce pain. When the calipers do produce pain, it is due to a pulling on the wounds in the skin, which was not stretched up well enough before the incisions were made, or it is due to a slipping of the calipers on the femur. Both are the results of faulty technique. The dressings around the incisions should be changed often enough to keep the wounds clean. Sometimes a little collection of serum occurs around the pins, which calls for daily, or less frequent dressings. Sometimes the wounds remain dry, and need no change of dressings for 2 or 3 weeks. I have followed no set rule in this regard.

Reduction of fracture. Roentgenographs should be made every 2 or 3 days, until the best possible reduction has been secured. Changes in the position of the splints, or lateral pressure on the thigh with pads, or the addition of more weight, should be carried out, as indicated by the roentgenographs. Corrections can be made while observing the fracture under the fluoroscope. Satisfactory reductions should be obtained in at least 6 or 7 days. In most cases it occurs in a shorter time. If the treatment has been correctly carried out, and reduction is not accomplished in this length of time, it must be concluded that some uncontrollable factor is interfering. Open operation then becomes necessary.

All patients can sit up, with a back rest, as soon as the fracture has been well reduced. In elderly patients this can be allowed sooner, if desired, with little chance of disturbing the reduction.

Physiotherapy. Movements of the knee joint are begun as soon as the fracture is satisfactorily reduced. This is done very gradually, increasing the extension or flexion of the knee by raising or lowering the foot piece a little, and then refastening it in the new position. It is left in this position until the next day, when another slight increase or decrease in the knee angle is made. By this very gradual daily movement, the knee is slowly flexed and extended during the period when callus formation is not yet sufficient to allow more

rapid or more extensive movement. When union is firm enough to prevent slipping of the fragments, as determined by roentgenographs and palpation, more extensive flexion and extension movements can be carried out several times a day. This is done by the rope which comes from the foot piece. The patient himself can do it if he can be trusted. If not, it is done by the nurse. Most patients do it very well. This usually can be started about the fourteenth day. The next step is the addition of some active contraction of the thigh muscles, while the passive movements are being done. This stage is usually reached about the third week, and from then on the active muscular effort is gradually increased, until very little assistance, by pulling on a rope, is necessary. Careful massage during this time, and stimulation of the thigh and leg muscles, with the foradic current, such as is supplied by the Bristow coil, are valuable adjuncts, if they can be given by a trained physiotherapist.

Removal of calipers. The calipers can usually be removed after 3 weeks, and are rarely needed after 4 weeks. I recently let them remain in a patient 2 or 3 weeks longer than they were needed, in order to note any trouble from their presence. They were removed at the end of 6 weeks, there being no symptom then which would indicate that any harm was being done. The traction can be continued with adhesive tape on the thigh, after removing the calipers, if it is thought that a little extension is still indicated. Do not make the mistake of substituting adhesive tape for the caliper while a considerable extension force is still necessary. The actual pull on the bone produced by adhesive is only a small fraction of that produced by the caliper. I recall an instance in which the fracture was being held very easily, in excellent position by the caliper. Adhesive tape was substituted, and roentgenographs, the next day, showed overlapping of an inch. The caliper was reapplied immediately, and in 24 hours an excellent position was again shown in the roentgenographs. No anæsthetic of any kind is needed when the caliper is removed. There is practically no pain, if it is removed without roughness. The pins seem perfectly free in the tissues, and no force is needed in removing them. The wounds left will be very small, and will need dressing only a few days.

Hip and knee joint movements. Following the removal of the caliper, the limb must, of course, be left supported, as before, in the splints. It is supposed that, by this time, there is only enough union to prevent a slipping or a deformity of the fracture while supported in the position of relaxed muscle pull. It is usually 3 or 4 weeks more before the limb can be taken out of the splints. During this time, the knee movements are increased in frequency and extent, and, at an appropriate time, movements in the hip joint are started. The nearness of the fracture to the hip will govern this. With the fracture close to the knee, the hip movements can sometimes be started as soon as the caliper is removed. With fractures higher up, this is delayed from 1 to 3 weeks.

Movements in the hip joint are started only after the caliper has been removed, and are governed in this way. The lower end of the Thomas splint is detached from the horizontal bar by unscrewing the two small clamps. The end of the splint is lowered a few inches, and then suspended from the horizontal bar by two straps. The next day, the splint is lowered a little more, and thus, gradually, the thigh is allowed to come down from the flexed, into the extended position. From this position, it can be flexed again, by pulling on the rope which attaches to the foot splint. This will first pull the knee into extension, and then the leg and foot splint will act to raise the Thomas splint, since the leg splint is wider than the Thomas. By pulling on the rope, the thigh can be brought back to the original degree of flexion. Thus, by the design of the leg and foot splint, and by its arrangement with the Thomas splint, both hip and knee movements can be produced by a single rope.

Removal of entire apparatus. By the time that there is sufficient union so that the support of the splints can be dispensed with, there should be good movement in the hip joint, with complete extension and good flexion in the knee joint. The patient can usually be taken out of the splints, and off the frame, in from 6 to 8 weeks. Exercises are continued in bed, and weight bearing started as soon as manipulation and roentgenograms show that union has become strong enough.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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JANUARY, 1925

HEPATIC FUNCTION

MANY physiological properties of the liver are known, such as its ability to form and excrete bile, its ability to store glycogen, and to maintain a constant level of blood sugar in health. In the metabolism of proteins, it receives amino-acids, as do other tissues of the body; de-aminization occurs and nitrogen is eliminated in the urine as urea. Recent improvement in biochemical methods makes it possible to measure accurately the above constituents in the blood, thus forming a basis of comparison. Our concern, however, is not with the variation in the individual constituents, except as they afford an index of the total.

Greene and Snell, of the Mayo Foundation, in an experimental and clinical study of the relationship of obstructive jaundice to hepatic function, by parallel and quantitative estimations of urea, amino-acids, sugar, and microscopic fat in the blood, found that neither singly nor collectively did these form an index of hepatic damage when compared with microscopic sections of the liver taken from patients suffering with obstructive jaundice.

Rowntree and Abel formerly demonstrated that the dye, phenoltetrachlorphthalein, was excreted by the liver in the bile, in proportion to the amount of hepatic damage. Rosenthal has shown that the duration of the retention of phenoltetrachlorphthalein in the blood stream after intravenous injection parallels the amount of hepatic damage. These results have been confirmed by Greene, Snell, and Counseller in their clinical and experimental study of obstructive jaundice. They have also observed that phenoltetrachlorphthalein, as a measure of hepatic damage, might be compared to phenolsulphonephthalein as an index of renal function, and as urea is retained in the blood in renal insufficiency, so bile pigment is retained in the blood in cases of obstructive jaundice.

There is a practical application of the Rowntree-Rosenthal test in estimating the risk of surgical procedures on a patient with obstructive jaundice. It has been estimated by Judd and Lyons that the operative mortality in cases of obstructive jaundice can be reduced to approximately 4 per cent by pre-operative preparation. Our concern at the present time is to reduce the 4 per cent to a minimum. In studying causes, it is interesting to note that the patients in the 4 per cent group are made up, on the one hand, of those who die from renal insufficiency following operation, the result of failure adequately to relieve the common duct obstruction, and, on the other, of those manifesting a clinical syndrome which Parham described in 1922 as having possibly originated in hepatic insufficiency. From a surgical standpoint it may be possible, in the future, to eliminate

this smaller group by means of the Rowntree–Rosenthal test.

WALTMAN WALTERS, M.D.

ARE RADIATIONS PROVEN TO BE OF VALUE TO THE PATIENT SUFFERING FROM MALIGNANT DISEASE

DURING the past twenty years a considerable volume of literature has been written on the value of radiation in the treatment of malignant disease. Is it possible to extract from this sufficient evidence to give an affirmative answer to our query?

The occurrence of dermatitis followed by malignancy in the experience of the early workers is well known and the means of preventing such unfortunate sequelæ are now understood.

Radiation from radium and X-rays has been used in varying strengths and has been applied by different methods in a variety of malignant conditions over a period of time long enough to establish its value, and yet today can we say that government or other statistics indicate that the lives of people suffering from cancer or carcinoma have been prolonged by radiation? Would not the evidence rather show that radiation from X-ray and radium is a new form of local treatment and only locally effective.

Many theories have been advanced to explain the action of deeply penetrating rays. One is that the lecithin present in the tissues is decomposed by the radiation and to the products of its disintegration are ascribed remarkable powers. As a matter of fact, as stated by Wakeley, this action upon lecithin has not been substantiated by subsequent research. Another view is that of specific activation of intracellular enzymes. Here, again, most recent investigations fail to demonstrate any such action, and experiments at King's College Hospital upon the oxidases lactase and tyrosinase fail to show any effect as to sequel to radiation. (Wakeley. The Arris and Gale lectures. Brit. J. Surg., 1924, July.)

We do know that radiations from radium and X-rays interfere with the blood supply of the tissues exposed. The endothelial lining of the smaller blood vessels is sensitive to radiations. The cells become swollen and vacuolated and there is a tendency to irregular proliferation into the lumen of the vessel and the vessel wall becomes infiltrated with leucocytes. These changes are not immediate but follow a latent period of several days.

Attention is now directed to the action of X-rays and radium on the blood. A severe and even fatal anæmia has occurred among insufficiently protected workers with X-rays and radium. The number of red cells has been found lessened and there has been a marked diminution in the number of lymphocytes and to a less degree of the polymorphonuclear leucocytes.

The action of radiation on the intestines may cause inflammatory conditions associated with diarrhœa and the passage of blood stained mucus.

It seems to be pretty well determined that radiations from radium and X-rays disturb the colloidal equilibrium of the cells with consequent devitalization. The proteins undergo a marked diminution in viscosity, and, as shown by Colwell and Russ in 1912, starch undergoes at any rate a partial change into soluble starch and dextrin.

These considerations are all interesting—but they do not explain the therapeutic value of radiation in malignant disease. That radiation has a local influence—often for the better, on local malignant growths has been demonstrated in many instances—but do they pro-

long life? They are analgesic, they are mentally comforting. Something is being done, and hope is stimulated. Do they do anything more? Only too often do we find, at autopsy a wide metastasis to the lungs and to other parts. Cancer in many people advances slowly. There seems to be present a resisting influence.

This limit of resistance may seem to be indicated by the difficulty in producing artificially more than one growth of cancer and by the rarity of more than one malignant growth in the same person. It has been stated that mice rendered immune to cancer lose their immunity after exposure to X-rays.

Clinical and experimental experiences suggest the question: Do radiations from X-rays and radium, while acting beneficially on the local lesion, at the same time lower the patient's resistance to the progress of the disease?

The results obtained by surgical treatment are available and if it can be shown that during a decade they have been improved by X-ray or radium radiations it would be very encouraging to research workers, to the profession, and to the public.

It is generally conceded that in the treatment of malignant disease of the mesoblastic tissues—the female generative organs and the kidneys—radiation finds its most favorable field. GEORGE E. ARMSTRONG.

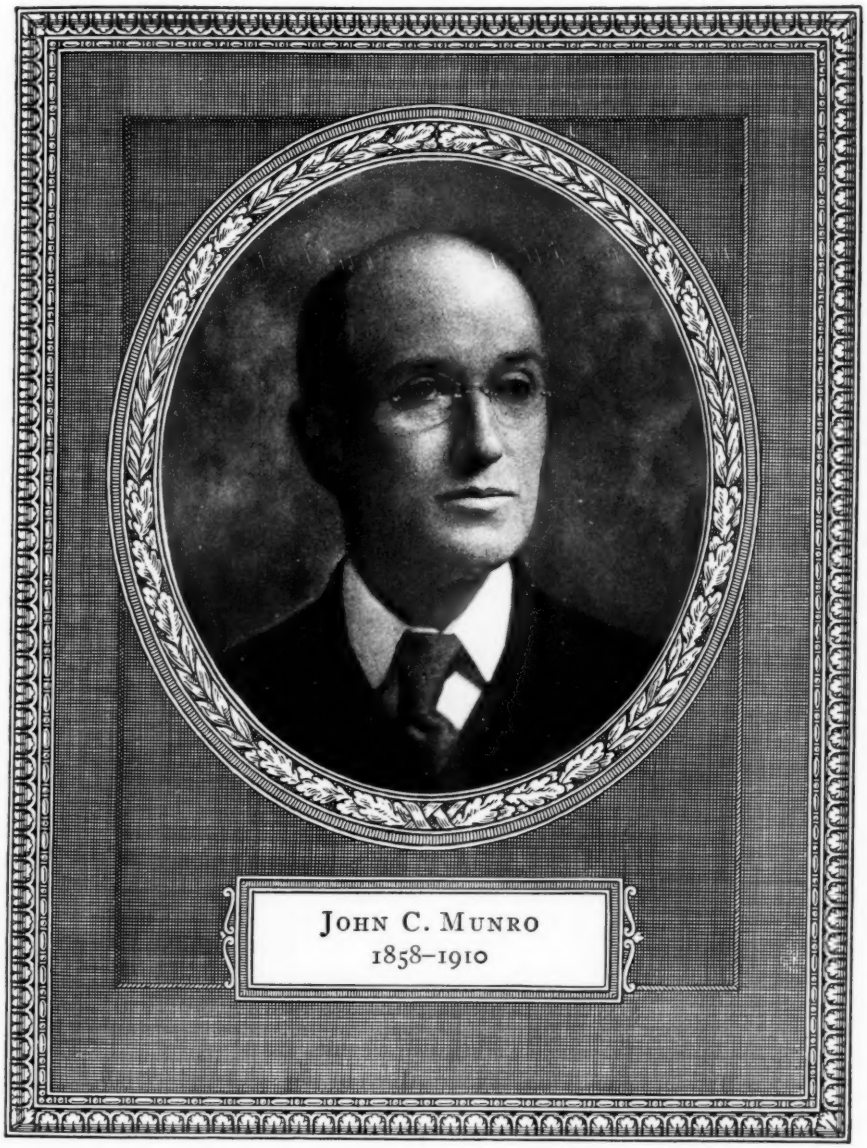
MASTER SURGEONS OF AMERICA

JOHN CUMMINGS MUNRO

JOHN CUMMINGS MUNRO, of a family long identified with the historic town of Lexington, was a thorough New Englander. The American Munros originated at Inverness, Scotland, where the Clan has a clear record from the eleventh century, and where Sir Hector Munro, Baron Fowlis XXIX, still occupies the original grant made, before 1034, by Malcolm II. The first of the name in Massachusetts was William, deported by Cromwell after the battle of Worcester for fighting under the Stuart king. This William settled about 1657 in Lexington—then Cambridge Farms—in a district still called "Scotland," and was the ancestor of fourteen Munros who, on April 19, 1775, stood up, with half a hundred other farmers, against eight hundred British regulars. The orderly sergeant of this little company of "Minute Men" was Doctor Munro's great-grandfather, William, who for many years was the host of the famous Munro Tavern, built by that William's grandfather in 1695. In a still older house, nearly opposite the Tavern, John C. Munro, second son of James S., was born, March 26, 1858.

His mother was Alice B. Phinney, descended from John, who came to Cape Cod soon after the Pilgrim settlement. Doctor Munro's grandfather, Elias Phinney, was a lawyer of standing and a pioneer in scientific agriculture. He came to Lexington in boyhood, was graduated from Harvard in 1801, and married Catherine Bartlett of Charlestown. Many of her family were distinguished in medicine. A number of Scotch Munros have been eminent in surgery, four of them occupying, in genealogical succession for more than a century, the chair of anatomy in the University of Edinburgh. John Munro inherited, therefore, a definite bent toward a profession which, from boyhood, he steadily expressed his determination to follow. In his youth, too, he showed keen interest in entomology and the use of the microscope.

Munro won the Franklin medal for good scholarship in the Boston Latin School, and entered Harvard with the class of 1877. Immediately upon graduation in 1884 he settled in Boston. He became associated with the anatomical department of Harvard in 1889 and for 6 years worked there assiduously. Joining the teaching staff of the surgical department in 1894, he continued that association for eleven years. He began his hospital connections in 1891, first as surgeon



JOHN C. MUNRO
1858–1910

to out-patients at the Carney Hospital and, later, as surgeon to the Boston City Hospital, where he remained until 1903. In that year he was appointed surgeon-in-chief at the Carney Hospital. This position he held until his untimely death.

Doctor Munro is probably best known through his clinic at the Carney Hospital, established in 1903. The opening of this clinic was an important event in New England, since it was the first permanent continuous service instituted in that section of the country. As its chief, he assumed responsibility for the conduct of the entire surgical department of the hospital and, under his guidance, the clinic rapidly achieved a high place among those of the United States. In it he demonstrated the possibility of doing satisfactory surgery, successful in its results, with a meagre plant, simple technique, and a minimum of red tape and assistants. There, too, he gave proof of the truth epitomized in a quotation to be found in one of his addresses: "The potency of the individual is greater and nobler than the influence of class or organization or even institution." The clinic was one of the best known and most frequented in New England.

A member of all the important national societies, Doctor Munro was a firm believer in the value of professional meetings and was a zealous attendant at both local and national assemblies. He was particularly devoted to the American Society of Clinical Surgery, of which he was president in 1906–1907. He was a fairly regular contributor to the literature of his profession and, in 1907, wrote for Keen's *System of Surgery* several chapters which are so fundamentally sound that with but few minor changes they are entirely acceptable today. His writings, as a rule, set forth conclusions drawn from his own extensive clinical experience and, since he had no hesitation in publishing his failures and his unfavorable results as well as his successes, these papers were always suggestive and were particularly valuable in a practical way. In professional discussions he took no position of which he did not, at the time, feel comparatively sure; and, while always courteous, he had the uncompromising attitude believed to be characteristic of the Scotch.

In the early days of gastric surgery he contributed greatly to its advancement not only in New England but in the country at large. He published valuable communications on the surgery of the biliary apparatus and on that of acute pancreatitis. He was greatly interested in hæmorrhagic pachymeningitis and added much to our knowledge of the worth of surgical measures in the treatment of that affection. He was one of the earliest and strongest advocates of prompt operation in appendicitis, and he called attention in no uncertain way to the danger of portal and lymphatic infection in neglected and improperly treated cases. Perhaps his most striking paper was that in which he advocated ligation of the ductus arteriosus in certain cases of atelectasis. Though this paper was not published until 1907,[1] the idea had been in his mind many years, and in the early nineties all the anatomical details had been so thoroughly worked out by him on the cadavers

[1] Ann. Surg., 1907, Sept.

of newborn children, that he regarded it as a justifiable procedure on the living in cases with beginning atelectasis or other evidences of impending death from circulatory disturbance. All this was a long time before cardiac surgery of any kind was in vogue and indicates how well in advance of his day he was in some surgical fields.

In an address before the Canadian Medical Association at Toronto, in 1909, he epitomized what is best and most important in hospital standardization of today. The title of that address is significant and arresting, "The Surgical Rights of the Public." He recognized that in the practice of surgery the rights of the patient are primary, paramount, and fundamental. In the same address he warmly advocated the development of a class of professional anæsthetists. He did not live to see his ideas develop into widespread customs but doubtless he then visualized what today are common usages.

He came from a community where, to use the words of President Coolidge, "folks are happy and contented; they belong to themselves, live within their income, and fear no man." Such communities are apt to breed over-conservatism, if not, indeed, provincialism; but Doctor Munro showed neither. He was one of the first, if not the first, surgeon of the Eastern States to recognize the value of the then small Mayo clinic and of other prominent clinics of the Middle West. He became a frequent visitor to them and urged the importance of such visits as an exceptional means of securing higher education in surgical craftsmanship and of broadening one's outlook in the field of surgery. While cherishing a proper respect for the old in medicine, he kept his mind open to new ideas and was eminently progressive.

He was admittedly a very capable surgeon. His hands, small and wondrously fashioned, were peculiarly adapted to deftness in work. His technique was admirable. He was not spectacular. Some considered his surgery bold. But they mistook for boldness that certainty of act which comes from accurate anatomical knowledge and from clear perception of the object to be attained. He was unafraid, because he had no uncertainty; he was rapid in his work, because he wasted no effort and made no unneccessary movement. He knew what he desired to accomplish just as clearly as he saw the shortest way to it, consistent with safety. Thus did he justify his long days of work in the dissecting-room and the anatomical laboratory. He was an accurate observer; he had a logical mind; he was familiar with the literature of his profession; he had a practical knowledge of pathology in the living. As a consequence; he was not only an able diagnostician but he gave due consideration to the problems presented at operation and made a wise choice of the operative procedure. His surgical judgment, always good, ripened with the years until it reached the high level of his masterly technique. The combination made him one of the best surgeons of his time.

Doctor Munro was an indefatigable worker to the point where his activities exceeded his physical strength. An institution with which he was connected in

his early days possessed a large surgical staff; yet most of the emergency work and the difficult cases came to his hands because his colleagues were less keen than he to acquire surgical experience. He never "played for a record." What procedure he considered best adapted to the pathological condition presented by the patient, that procedure he carried out. He never allowed himself to do a relieving operation, although it might be easy, where a curative one was indicated.

He was of a modest, even retiring disposition. Once known, he was eminently social and was one of the most popular members of the Tavern Club, where many of the best in the artistic, professional and intellectual life of Boston foregather. By his close friends he was greatly beloved.

Charity, kindness, and consideration walked with him daily. His honesty was transparent and he looked at the world through eyes of truth and faith. Once he saw truth in another, his faith in and his loyalty to that other were necessary sequences. He had a strong sense of justice and was disposed to give every man his full due. He knew no guile and practised no deceit. His admiration for Doctor Edward R. Squibb, whose daughter he married, was unbounded. The minds of both men were molded after similar patterns; both had similar objectives; the one to manufacture the very finest products of the laboratory, the other to offer his best for suffering humanity; to both the monetary reward was wholly secondary.

He was a man of simple tastes and quiet culture. He possessed an extensive library, selected with discrimination, and found his chief recreation in reading and in music, of which he had unusual knowledge. He played with skill and remarkable sureness of tone both the violin and the viola, and in college was leader of the Pierian Sodality.[1] To the end of his life he associated himself in ensemble-work with various groups of enthusiastic amateurs. In this way he read a great deal of important music and kept himself in excellent practice. While his devotion to his profession gave him little time for participation in civic affairs, he was, nevertheless, a distinct asset to the community through the influence of his character upon the younger men who came directly or indirectly under his instruction.

He died on December 6, 1910, at the zenith of his powers and at a time of life when there was every reason to anticipate many more years of brilliant, productive work. In his final illness, which was long and painful, he was resolute, unafraid, and uncomplaining. He died as he had lived, a very gallant gentleman.

JOHN T. BOTTOMLEY.

[1] A famous Harvard musical organization.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha

BANISTER'S ANATOMY

THE dawn of surgery in England may fairly be said to begin with the Elizabethan period. Henry the Eighth was gone and with him a great part of the national unrest. The great cardinal Wolsey had died, almost in disgrace in 1530 and times were ripe for a change. Ten years later, in 1540 John Banister was born, just where is not known. Where he began his studies is also obscure and the first definite knowledge of him is when he accompanied the soldiers of the Earl of Warwick into France as a surgeon. On this expedition he met William Clowes, later also to become a well known surgeon, and a friendship began which lasted throughout life. At this time he was evidently not regularly graduated for he subsequently took a Bachelor's degree at Oxford and obtained his license to practice medicine. He first settled in Nottingham, the country of Robin Hood and Friar Tuck, where he practiced for several years until the wanderlust again called him and he served on ship for the Earl of Leicester in his expedition to the Netherlands. On his return in 1588 he settled in London and renewed his friendship with Clowes becoming closely associated with him.

His period of writing began before his permanent removal to London. In 1575 he published his monograph on ulcers which he entitled "A needfull, new and necessarie treatise of chyrurgerie, briefly comprehending the general and particular curation of ulcers, drawen forth of sundrie worthy wryters but especially of Antonius Calmeteus Vergesatus, and Joannes Tagaltius. Hereunto is annexed certaine experements of mine own invention, truly tried, and daily of me practiced." As shown by the title it was mainly a compilation, and Banister was principally a compiler and editor, though occasionally his notes and emendations show considerable originality. Later he published a translation of the work of Wecker and also a surgical antidotary.

From his experience Banister believed that the great fault among the surgeons in England was ignorance of anatomy, for in his introduction he says: "At last I called to remembrance, that the greatest want that raigneth in chirurgians at this day, is ignoraunce in the subject of their worke, waying also on the other side, that no English Author, which hitherto hath written hath sufficiently applied his tyme to the amendment thereof. Then was I wholly overcome in this purpose, and then did I clearely see, how that to write methodes or meanes to cure the affected partes of the body, the partes themselves beyng altogether unknowen, or falsely imagined of, might rather be a meane to indurate the cataract of inscience then to eate it through, or take it away"—So he set himself to compile his anatomy which he calls "The Historie of Man, sucked from the sappe of the most approved Anathomistes, in this present age, compiled in most compendious fourme, and now published in English, for the utilities of all godly Chirurgians, within this Realme, by John Banister, Master in Chirurgerie, and Practitioner in Phisicke."

The book, published in 1578, is a compilation of the then known anatomy and Banister tries to harmonize the differences of opinion of the famous anatomists. He bases the work principally on the anatomies of Galen, Vesalius, and Columbus and explains the differences in opinion along evolutionary lines, claiming that human bodies have changed with the years. To the anatomical descriptions, he adds the use of the different parts of the body and the work might be classed as a physiology as well as an anatomy. There are but four illustrations taken from Vesalius. This strikes one as rather strange as so many illustrations were at hand for him to use and as it was the first anatomy published in English it would have been more useful had it been more fully illustrated.

As a final preface to the work Banister publishes two letters of commendation—one in Latin, "Julius Borgarucius to his friend Banister," and the other in poetry, "William Clowes Chirurgian to his lovyng friend John Banister."

In the "Epistle to the Chirurgians" the author gives us a glimpse of the fact that all was not smooth sailing in medicine, then as now, for, after dedicating his book to all true surgeons, he goes on to say: "As for you, O ye chaffe of the earth, ye stinge of the Godly, ye Impes of Hell, and children of Wrath, you (I say) that, under pretence of the sacred Arte of Medicine, devoure the sheepe of Gods pasture, flea the laboures in his harvest, and denye your Lord the fruites of the vineyard: . . . . . And I (in these my labours) from the depth of my hart renounce you, hopyng assuredly, that from none of the flowers of this Garden any of you shall take opportunitie to sucke that, whiche may maintaine the infection of your pestilent wretchednesse hereafter." Powerful language but undoubtedly heartfelt

THE
Hiſtorie of Man, ſucked from the ſappe of the moſt approued Anathomiſtes, in this preſent age, compiled in moſt compendious fourme, and now publiſhed in Engliſh, for the vtilitie of all godly Chirurgians, within this Realme, by *Iohn Baniſter*, Maſter in Chirurgerie, and Practitioner in Phiſicke.

Ter. And.

Si illum objurges, vita qui auxilium tulit,
Quid facias illi, qui dederit damnum aut malum?

If that for him that aydes thy lyfe, thou chidynges vp doeſt lay?
What canſt thou do to him that hurtes or ſeeketh thy decay?

AT LONDON,
Printed by Iohn Daye, dwellyng ouer Alderſgate.

Anno. 1578.

Cum gratia & Privilegio Regiæ Majeſtatis.

REVIEWS OF NEW BOOKS IN SURGERY

ONE of the chief requisites of the surgeon is the knowledge of pathology. His knowledge of pathology is the guide which dictates the type of operation he should perform, and prognosticates what the results may be. More than this, a thorough understanding of pathology is no doubt the basis of "surgical judgment," since a complete pathological study must include all the variations from the normal in structure and function. The application of this knowledge of the response of the individual to processes, be they traumatic, chemical or neoplastic, is "surgical judgment."

McFarland[1] in his recent work, attempts to bring the study of pathology to the bedside of the patient as well as into the operating room. The surgeon must be his own pathologist in many instances, since he cannot avail himself of competent service at all times, and especially at times when decisions must be made. The success of the surgical procedure is in almost direct ratio to the correctness of the pathological deductions. This is not intended to minimize the importance of surgical technique, but operative technique when compared with surgical judgment is relatively simple and easily learned.

The scope of this work is rather unusual, as evidenced by the most interesting description of the evolution of the breast. In this comparatively short discussion, the author points out the importance of knowing the changes that take place in the normal breast from the time of birth, through maturity and pregnancy. His exposition of facts, when mastered, will prevent many errors of the surgeon and offers the first logical explanation for certain vague pathological affections of the breast.

The author pleads for more careful reading and studying of the text as there is "no short cut to knowledge or wisdom."

The reviewer very heartily recommends this work, not only to the student, but to the experienced surgeon, because of the very lucid descriptions of pathological processes. J. A. WOLFER.

THE reviewer derived much benefit and pleasure from reading the recent edition of the *Collected Papers of the Mayo Clinic*.[2] This volume consists of a series of most interesting papers, many of them bringing out new ideas and fundamental facts. Practically every branch of medicine and surgery is covered in some phase or other by such scientists as Rosenow, Plummer and Mann. The yearly contributions of these men always add to the sum total of medical and surgical knowledge. We may question certain deductions, yet the trend of thought is forward. The medical profession will welcome, as usual, the observations and conclusions of W. H. Mayo and Charles Mayo.

As stated in the foreword, "The present volume is a complete reference record of all papers for the year 1923 from the Mayo Clinic and the Mayo Foundation, every such paper being published therein complete, abridged, abstracted, or, by title."

A review of such a volume is evidently impossible In this one volume is to be found the compass of present day medical progress. J. A. WOLFER.

THE recent work of Thorek has been studied by the reviewer with much care and consideration. The contents of this volume[3] may be divided into two distinct parts: the first dealing with the usual diseases of the testicle and the other with the internal secretion. The description of the ordinary pathological lesions, such as tumors and inflammations, is too brief. In this the author has failed in giving the data which a work of this scope should cover.

In the second part is presented a rather comprehensive review of the literature on the subject of the internal secretion of the testicle, and yet there seems to be much missing. It would seem that the author is endeavoring to prove a problem and that his endeavors are misleading him. One is reminded of the remark of a very prominent research worker who cautioned his assistants in research problems: "Be very careful in your work for fear you will find what you are looking for." It would appear that the author, along with many other workers, has fallen into this pitfall.

There is no doubt but that the testis plays an important rôle in the physical economy, and that the testicular elements are subject to certain influences which may affect other essential organs of the body. The question may well be asked: Is the change in the testicle primary and the sole cause of the symptoms or is this change simply coincident with changes taking place in other organs of the body, such as the thyroid, the adrenals or the pituitary gland, the cause of which may be undetermined, as is the responsibility shared by these various organs in the production of the symptoms? It is pleasing to note that the author is rather reserved in making definite statements, yet the results obtained in various experiments are often given too much credence.

Mott's theory of dementia præcox is given no little attention and the author, it would seem, is rather inclined to accept it, subject to further study. Here again it would appear to the reviewer that the author is over enthusiastic about the results of testicle trans-

[1] SURGICAL PATHOLOGY By Joseph McFarland, M.D., Sc.D. Philadelphia: P. Blakiston's Son & Company, 1924.

[2] COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by Mrs. M. H. Mellish. Vol. XV, 1923. Philadelphia and London; W. B. Saunders Company, 1924.

[3] THE HUMAN TESTIS; Its Gross Anatomy, Histology, Physiology, Pathology, with Particular Reference to its Endocrinology, Aberrations of Function and Correlation to other Endocrines, as well as the Treatment of Diseases of the Testicular Secretions on the Organism. By Max Thorek, M.D. Philadelphia and London: J. B. Lippincott Company, 1924.

plantation. "It's all right to entertain a theory but it's dangerous to be entertained by one."

The author deserves due credit for presenting this work to the profession, and although the reviewer cannot agree with many of his deductions, this work may be the stimulus for further study and research which will ultimately prove or disprove Thorex' contentions. J. A. WOLFER.

MERCIER,[1] in a study of the painful syndrome of the proximal colon, limits his investigation to constipation resulting from a morbid state of the right colon. He thus restricted his studies because he found that right stercoral stasis has a symptomatology complicated by many resulting troubles and is especially amenable to surgical cure. Constipation due to large bowel atony or ptosis is admittedly not for surgical treatment. Although the indications for surgical relief (once so radical with Lane) of constipation are now more precise, it is acknowledged that resections and anastomoses alone will not cure the painful syndrome of the colon; medical treatment must be added.

In an orderly manner etiology, pathology, symptoms, and treatment are discussed. All theories of causation are covered and various operations for relief are described and illustrated. Patients' records and a bibliography are appended. This serious study is highly recommended by the reviewer for the critical study of American surgeons.

KELLOGG SPEED.

[1] ÉTUDE DU SYNDROME DOULOUREUX DU COLON PROXIMAL. By Le Docteur Oscar Mercier. Paris: Amédée Le Grand, 1924.

AFTER discussing the anatomy, physiology and movements of the small and large bowel, Simeoni describes intestinal exclusion[2] as a surgical operation which aims to interrupt anatomically a section of the intestinal tube. Such a loop is returned to the abdominal cavity with its circulation intact.

The following classification is made:

Exclusion
- Anatomical
  - Bilateral
    - Closed
    - Open
  - Unilateral
    - Closed
    - Open
- Functional
  - By enteroanastomosis
  - By artificial anus

Each division is taken up with a complete review of its literature and a résumé of the clinical cases found. Technique of operation, pathology, and experimental work on this subject, with the conclusions reached follow. Such an extensive monograph demands recognition in the field of surgical physiology in which it clears up many serious problems.

KELLOGG SPEED.

[2] ESCLUSIONI INTESTINALI (TRANNE IL PILORO); INDICAZIONI—RICERCHE—RISULTATI. By Vincenzo Simeoni. Naples: Rassegna Internazionale Di Clinica E Terapia, 1924.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

NORMAL BONES and JOINTS. By Isidore Cohn, M.D., F.A.C.S., with a foreword by Rudolph Matas, M.D. New York: Paul B. Hoeber, Inc., 1924.

TRAITEMENT CHIRURGICAL DE LA DILATATION BRONCHIQUE. By P. Guibal. Paris: La Presse Médicale, 1924.

STUDENTS' GUIDE TO OPERATIVE SURGERY. By Alfred T. Bazin, D.S.O., M.D., assisted by F. A. C. Scrimger, V.C., B.A., M.D.; F. J. Tees, M.C., B.A., M.D.; L. H. McKim, M.D.; I. McL. Thompson, B. Sc., M.B., Ch. B. Montreal: Renouf Publishing Company, 1924.

MIDWIFERY MECHANICS. By Lieut.-Colonel Andrew Buchanan, I.M.S. (Retd.), M.D. New York and London: Oxford University Press, 1924.

A TEXT-BOOK OF SURGICAL HANDICRAFT; for the use of medical students. By J. Renfrew White, M.S., F.R.C.S. (Eng.) New York: The Macmillan Company, 1924.

THE CLINICAL EXAMINATION OF SURGICAL CASES; for the use of students. By J. Renfrew White, M.S., F.R.C.S. (Eng). New York: The Macmillan Company, 1924.

PRACTICAL SURGERY ILLUSTRATED. By Victor Pauchet. Vol. i & ii. London: Ernest Benn Limited, 1924.

OPERATIVE SURGERY. vol. v. By Warren Stone Bickham, M.D., and Phar. M., M.D. Philadelphia: W. B. Saunders Company, 1924.

LANG'S GERMAN-ENGLISH DICTIONARY; of terms used in Medicine and the Allied Sciences. Edited and revised by Milton K. Meyers, M.D. Philadelphia: P. Blakiston's Sons and Company, 1924.

NOTES ON PATHOLOGICAL AND OPERATIVE OBSTETRICS. By Lyle G. McNeile, M.D. Philadelphia: Lefax, Incorporated Publishers, 1924.

AIDS TO SURGERY. By Joseph Cunning, M.B., B.S., F.R.C.S. (Eng.) and Cecil A. Joll, M.S. (Lond.), F.R.C.S. (Eng.). New York: William Wood and Company, 1924.

FACIAL SURGERY. By H. P. Pickerill, C.B.E., M.D., M.S.; with an introduction by Sir W. Arbuthnot Lane. New York: William Wood and Company, 1924.

APPLIED ANATOMY. By Gwilym G. Davis, M.D. Philadelphia: J. B. Lippincott Company, 1924.

GYNECOLOGY. By Brooke M. Anspach, M.D. Philadelphia: J. B. Lippincott Company, 1924.

OBSTETRICS, NORMAL AND OPERATIVE. By George Peaslee Shears, B.S., M.D. 4th ed., revised by Philip F. Williams, Ph.B., M.D. Philadelphia: J. B. Lippincott Company, 1924.

ANATOMY OF THE HUMAN BODY. By Henry Gray, F.R.C.S. 21st ed. Philadelphia and New York: Lea and Febiger, 1924.

PATHOGENIC MICRO-ORGANISMS; a Practical Manual for Students, Physicians and Health Officers. By William Hallock Park, M.D., Anna Wessels Williams, M.D., and Charles Krumwiede, M.D. Philadelphia and New York: Lea and Febiger, 1924.

LES COLOTYPHLITES ET LE SYNDROME DE LA FOSSE ILIAQUE DROITE; (APPENDICITES, PÉRICOLITIES, COLOTYPHLITES). By Le Docteur A.-C. Guillaume. Paris: Librairie Octave Doin, 1924.

AMERICAN COLLEGE OF SURGEONS

THE YEARS BETWEEN[1]

By W. W. CHIPMAN, M.D., F.A.C.S., Montreal, Canada

THE fellowship address of this College confers a great honor, but it also entails a great responsibility. There is always the price to pay. I thank you for this honor, even though I am face to face with the inevitable obligation. I recall to mind the many distinguished men whom you have honored in this way, and I thank you on my own behalf, on behalf of McGill University, and the country which I represent.

The present is but our twelfth convocation, though that November day in Chicago, in 1913, our first convocation, seems such a long time ago. The world has traveled far in the last 11 years; nearly half of these, the years of an actual Armageddon. In the history of mankind, they have been written as stricken and saddened years —a veritable carnival of waste—and there is revealed as yet no adequate recompense. And these have been the first years—the childhood years—of the American College of Surgeons.

History has shown us long ago that collective life, the life of any nation or of any polity, large or small, even as that of the individual himself, passes of necessity through the stages of childhood, of youth, full vigor, and of senescence. So the days of our years have been numbered, for ourselves as for any society, the daytime of our achievement. And we do well to be mindful of these years.

The American College of Surgeons stands at the Gateway of Youth, with the years of its childhood behind it; and this Gateway is the first milestone, if you like, of its long life-journey. I propose tonight to say something of these childhood years, to take stock, as it were, of this first stage of the journey; and I shall indicate also some of the problems that immediately confront us. Very rightly have we been told that the future is but the past entered through another door, and so I designate what I have to say as "The Years Between."

May I remind you that, while I have been identified with the Executive of this College through the greater part of its life—I had the honor of being its first vice-president—I stand altogether in the position of the friendly neighbor. A great personal friend from Missouri frequently reminds me that, as a Canadian, I inhabit merely the chill subarctic fringe of God's Own Country. Accordingly, my remarks will naturally be clothed in a Northern, if not in a polar, phraseology; but, by very reason of this distance, they may evince perhaps an additional perspective. Most assuredly, they must not be considered of the nature of an *Apologia;* for what is written is written.

And now what are the assets of these years, and what of the work that we have already accomplished?

How distinctly we remember that the College was organized in May, 1913, by 450 of our prominent surgeons. At this beginning we organized ourselves, and were really not unlike the famous blacksmith who, suspending himself by the waistband with one hand, was yet able to work with the other. However, we soon got our feet upon the ground, and both hands free for service, as now there are 67 honorary Fellows, and 6,583 ordinary Fellows of the College. These honorary Fellows include many of the most distinguished surgeons in all the world, and, so far as I know, no one, however distinguished, has declined this honor. The ordinary Fellows belong almost entirely to the Western Hemisphere: namely, North and South America, and the Islands of the adjacent Seas.

The government of this College of the Western Hemisphere is no small, or light, undertaking. It is vested, you remember, in 150 Governors, 16 Regents, and 5 Officers; and to implement these, an Executive Committee of 7, 4 of whom are Regents, while three officers of the College sit *ex officio.* The United States Army and the United States Navy, and the sixteen surgical associations and societies of North America, nominate 30 members of our Governing Board.

I mention these familiar facts merely to emphasize the compact, yet representative, nature of our government. Sir Harold Stiles, in his Fellowship address in Philadelphia, in 1921, described this governing machinery as a "power-

[1] Fellowship Address, delivered at the Twelfth Convocation of the American College of Surgeons, New York, October 24, 1924.

ful 'thought-organization,' capable of originating and carrying out an enlightened and far-reaching policy."

The College already occupies a dignified home in the city of Chicago, thanks to the generosity of a group of its citizens, both lay and professional. The John B. Murphy Memorial Building, with its Memorial Hall, its growing Library and Literary Research Department, is a conspicuous and handsome addition to the home of our College.

We already enjoy an Endowment Fund of $622,000, duly invested in gilt-edged securities.

The activities of the College may be realized by the mere mention of the several Committees, and the work already undertaken.

There is, first, the Credentials Committee together with a sub-committee for each State, Republic, Province, or Dominion; and associated with these, an active and hard-worked Committee on History Reviews. These committees adjudge each candidate for fellowship. And I need not tell you that their work is onerous, somewhat thankless and exacting.

Hospital Standardization has been from the beginning a large and important part of the College work; and the wide field of its activities is the many and multiform hospitals of this great country. This sustained and successful effort has truly been a gigantic task. From the first, the College was impelled to this undertaking by the fact that all applicants for fellowship were required to submit, as part of their examination, a number of their own case reports. These applicants naturally turned to their hospital records, only to find, not infrequently that these records, if not altogether wanting, were fragmentary and incomplete. This individual demand for case records was really the initial cause of the movement; but, as the years have passed, the idea of hospital betterment has grown and developed, and has now come to include not only the matter of records, but the inevitable sequence of staff organization and improved laboratory service. In this way, a hospital standard has been evolved, variously adapted, as you know, to embrace teaching and non-teaching hospitals, the so-called "closed" or "open" ones, and those both large and small. This standard represents a requirement that is really within the reach of all hospitals, and it has come to be known in the college terminology as a "Minimum Standard."

It is impossible, I think, to overestimate the value of this work and the good that will accrue. Assuredly there was a large, a disjointed, and a somewhat ramshackle house to put in order. Good case records imply the same guarantee of good work in a hospital as good bookkeeping does in any business. And woe to the hospital or business where no such books are kept. It is quite true that the "Minimum Standard" still remains low, but 11 years, be it remembered, is but a beginning, and even as any other vertebrate, a hospital must creep before it walks.

In a very true sense, a hospital may be considered as the measure of any civilization, not only for a community or a city, but even for a people. How do we treat the sick and the afflicted? Are we in any practical way our brother's keeper?—and we need not be altogether ashamed of the answer. I am proud to say that our hospitals show a manifest and growing ambition to elevate their standard, to be included and retained with the elect. And this feeling is as strong in Canada as in the State of Illinois; in California as in New York. Movement is a law of life, and the urgent concern of the College is to ensure that this movement proceed in the right direction. We cannot stand still. Our present standard is only "a minimum," and the very name implies a possible progress toward higher and better things.

The labor already directed toward this end has been enormous, and has comprised seven annual surveys of the 100-bed hospitals in the United States and Canada—we began with these—three surveys of the 50- to 100-bed hospitals, and the first survey of the 35- to 50-bed hospitals. Of these 2,366 hospitals, 1,427 have already been "approved," and in them there were treated during the past year 4,558,840 patients. However, even with our minimum standard, the work is not complete, for 34.1 per cent of our hospitals, more than one-third, remain still "unapproved."

Speaking of Operations (you may remember the book), I wonder if you will agree that this country of ours endures an abundance of surgical ministration, that it is "over-surgicalized," if I may coin the expression. Bernard Shaw somewhat unkindly remarks that there is a fashion in operations as there is in sleeves and skirts. In all conscience, quantity we have, whereas for our bodies' health and integrity, it is rather quality that counts. The urgent need, I take it, is not for more, but rather for less; and that this less of our surgical service should be more carefully trained and selected. And this represents our College requirement. Good surgery is a difficult, a responsible, and a painstaking business.

The annual Congress and Convocation, and the various Sectional Meetings, represent the public activities of the College throughout the year. By this means our College becomes, in a

general way, articulate. We live in a country of great distances, and it is the Sectional Meetings, either state or provincial, that serve most effectively to unify us, to bind the separated communities together. During the year 1923, some 22 of these sectional meetings were held, 8 of them in Canada. The organization and the conduct of these meetings pertain always to the local men, who, under the aegis of the College, are often stimulated and encouraged more completely to find themselves.

The growing affiliation with Latin-America deserves special mention. Four official visits have already been made, and our College has been strengthened by the addition of 16 honorary Fellows and 198 ordinary Fellows, selected from the surgeons of these several countries. Already the College is Pan-American in something more than name.

There is every reason why our College should soon become a national clearing-house in the matter of surgical practice and achievement. It is only in such a general way that we can adjudge the sound measures of treatment, and assay the value of any new method or discovery. With all our many schools and societies, there is great need of a final Court of Appeal, or some such general tribunal. A beginning has already been made by the College in the appointment of several special committees, composed of men distinguished in their respective lines of work. The following are the subjects at present being studied, each by its own committee: (1) Treatment of Malignant Diseases by Radium and X-Ray; (2) Treatment of Fractures; (3) Standardization of Clinical Laboratories and (4) Registry of Bone Sarcoma. Such work is unobtrusive, yet it represents a sound beginning to a national service.

The official journal of the College is SURGERY, GYNECOLOGY AND OBSTETRICS, one of the best publications in the medical world, and this valuable asset the College may later inherit.

May I now be spared a word for the amenities? The first convocation of our College was honored by an address delivered by Sir Rickman Godlee, the president of the Royal College of Surgeons of England. He brought to us greetings from his Royal College, which expressed the hope that our "American College should have a successful career, and fill a position beneficial alike to the profession and the community." Last year the fellowship address was delivered by Sir William I. DeCourcy Wheeler, the president of the Royal College of Surgeons of Ireland. In 1921, Sir Harold Stiles brought us a message from the Royal College of Surgeons of Edinburgh; and the following year, Professor Raffaele Bastianelli came to us from Rome.

In its seventh year, the College was presented with the Great Mace, which is carried before us at all convocations. Though far removed from its belligerent use as a weapon of defence, it still remains a significant emblem of authority. Very happily, it always seems to me, the Mace was presented to us at our meeting in the city of Montreal, for it is designed to tell, in a symbolic way, of the close union that exists between British and American surgery. The inscription on the Mace speaks of it as a gift "from the Consulting Surgeons of the British Army to the American College of Surgeons, in Memory of Mutual Work and Good Fellowship in the Great War, 1914–1918." As you see, the national floral emblems of the United Kingdom—the rose, the thistle, the shamrock, and the leek—decorate the staff, which supports the head with its crown-shaped final, upholding the "Sacred Flame of Science." This head is adorned by six panels, which set forth the following "Achievements at Arms":

1. The full Blazon of the United States of America,
2. The Dominion of Canada,
3. The Royal College of Surgeons of England,
4. The Badge of the Royal Army Medical Corps,
5. The Shields of Arms of John Hunter and Lord Lister,
6. A Cartouche bearing the words, "Philip Syng Physick, 1768–1837, Father of American Surgery."

In his graceful presentation of this Mace, Sir Berkeley Moynihan said: "We pray God may regard it as a symbol of our union in the harsh days of trial, as a pledge of unfaltering and unchanging hope, that the members of our profession in the two lands shall be joined in brotherhood forever in the service of mankind."

The John B. Murphy Oration is a fitting tribute to the memory of one of our own great men.

So much for the assets of these years, and assuredly, it has not been an idle childhood. The mention of any names I have purposely omitted, for we all know the names of those who have really founded the College; whose idea and whose conception it was. Some of these men are present this evening, and their names are safe within the keeping of the College history. You will forgive a personal reference to Father Moulinier—to his unique and signal service in the interests of our College; and also the mention of the zeal and devotion of the two associate-directors, Dr. MacEachern and Dr. Craig.

I shall now consider some of our present problems, making first two general observations. These observations will deal, the one with our definite re-action to this large undertaking; and the other with the form of our College government.

In his inaugural address, Sir Rickman Godlee warned us that we, as a College, would indeed be fortunate if we escaped the criticisms sometimes made against his College, of proceeding "either with too great temerity, or with excessive caution." These words were kindly meant, and yet they only half-concealed the sense of prophecy within them. Do not the gods themselves declare that, within the experience of any corporate, living thing, there is no laudable escape from self-analysis and criticism? Indeed, such criticism is dynamic, a sign of life itself, a "stirrage"; and, were there none of it, the fear would be that we were dead already. As a Regent of the College, I gladly acknowledge this, and I humbly welcome any criticism; I mean, of course, the helpful, honest, non-self-seeking sort. I confess I am unaware of any dearth in this respect, for, in our short auspicious life, there has always been no lack of "stirrage."

As regards the definite reaction to our undertaking, we do well to keep before our minds that the object of the College is to elevate, in a universal way, the standard of all surgery. In the terms of our Constitution, we specifically declare this, for the College professes to be fundamentally concerned both with the character and the training of its Fellows; to be concerned with the improvement of hospitals, with the elevation of general medical education, and with an unselfish protection of the patient from immature and incompetent surgery.

Assuredly this College is a large order, which we have so cheerfully undertaken. I repeat that the need of such organization is great; and, may I say at once, that I truly believe that the College has already rendered no mean account of its young stewardship. By all the rules of life, we do wrong to demand a premature growth of development; for no Rome was built in a day, and time is an essential factor in any creation. It remains fortunately true in all human things that it is impossible to place the man's head on the boy's shoulders; for so much of the boy is but a promise of fulfilment. Impatience is, perhaps, one of our national sins; an overeagerness to attain to what we call "results." As an illustration, may I remind you of the famous Emile Coué and his couplet:

"Day by day and in every way,
I am growing better and better";

Coué tells it that two days of this iteration was enough for our average citizen; and that, on the morning of the third day, after repeating the formula, he impatiently ejaculated, "Oh Hell, I am well!", a somewhat premature anticipation of the result. It remains as true today as when it was written that "He that believeth shall not make haste."

The second observation concerns the form of our College government. In my judgment, this government is not only representative, but simple and effective. As proof of this, let me remind you that, of our 50 Governors elected each year by the Fellows for a term of 3 years, 30 are nominated by the 16 representative surgical societies of this country. The 16 Regents are chosen by these Governors for a term of 3 years. They are in reality a Board of Trustees, in that they appoint the Director-General and the Treasurer, and transact all detailed business. Four of these Regents, with the President, the Director-General, and the Treasurer of the College, serve for 1 year as an Executive Committee. Of all these officers, the Director-General alone is full-time, and a paid official; he holds office during the pleasure of the Regents.

It may be of interest to compare this governing machinery of our College with that of the Royal College of Surgeons of England. This Royal College is somewhat older than ours, for it began its corporate life 179 years ago. It has 17,000 members, and 1,589 Fellows. Its affairs are managed by a president, two vice-presidents and a council of 24 members, elected by the Fellows from among themselves, for a term of 8 years. This Council meets once a month, most of the work is done by committees, and there is no salaried, full-time official. You will at once observe that the 17,000 members of the College, its large proletariat as it were, have no voice whatever in the direction of affairs. Their entrance to fellowship and to manhood suffrage in this government, is only by means of a rigid examination.

This comparison is instructive, and comforting perhaps, inasmuch as it shows our College to be the more democratic, and further removed from any form of class government. But "morning never tries you till the afternoon," and with us it is much too soon for any complacency. These two systems can be truly measured only by results; and even in our own College there is yet no visible sign of a coming millenium.

It is quite true that we are all born to believe that a democracy is the highest form of government, but we have likewise come to learn that it

has as yet an inherent weakness, in that it demands so much of the average man. And the greater number of us are only average. It cost us something, you remember, to "make the world safe for democracy"; and now the much larger task confronts us of making democracy safe for the world. Nicholas Murray Butler, the president of Columbia University, has very clearly expressed these views in a recent address, entitled, "The Discontent with Democracy." In this address, speaking of our political life, he tells us: "We Americans have created so much governmental machinery, that we cannot get any effective governmental product"; and he then pertinently adds, "progress in government is a matter of deeds and not of phrases."

All this is but a plea for an enlightened commonwealth, and there is a lesson here for each one of us. So far as our College is concerned, we, like Kipling's McAndrew, need have no "doubt for the machine," but what about the man?—for that man is our average Fellow. The destiny of the College is in his hands.

Our present problems are naturally concerned with questions of policy, and the chief matters before the College have, directly or indirectly, to do with our entrance requirements.

In the United States and Canada, we have 30,000 practicing surgeons, and one out of every six of these is a Fellow of the College. With this number there is no ground for any substantial quarrel, and a considerable effort has been made to render it evenly representative. Six thousand surgeons constitute a nucleus sufficiently large to control our surgical metabolism. We are mindful too that we have lost by death a hundred of our Fellows every year.

I do not deem it advisable to set a fixed limit to our numbers—there should always be room enough and to spare for any good man. Accordingly, this limitation should not be arbitrary, but the result rather of a natural selection, a survival of the fit.

There is no question, I take it, but that in the best interests of the College, we must elevate the standard of our requirements; and that we must see to it that this bettering process should be executed in such a way as to "encourage the others," and to escape any large injustice. It goes without saying that any such new regulation will chiefly affect the coming generation. The Junior Candidate Group is an experiment along these lines, which at least has served to show the interest of the College in this matter.

I repeat, that we must raise our entrance standard, and I believe that we will be inevitably driven toward an entrance examination. Surgery is a science as well as an art, and there is no safe escape as yet from academic methods. Granted such an examination, it must not only be created by ourselves, but maintained by ourselves; it should be entirely independent of any medical school, though I agree that the examiners should always be chosen from those who teach.

This question is widely, and deeply connected with the whole problem of medical education. You cannot make bricks without the proverbial straw. Henry S. Pritchett, the president of the Carnegie Foundation, told us in 1910, 3 years before the foundation of our College, that we had in this country 155 medical schools, and that nearly half of these were entirely inadequate. At the same time, Abraham Flexner, in his report to this Foundation, declared that "our medical education includes something of what is best, and all of what is worst, to be found among civilized nations." Today, what a change has come over the spirit of our dream! In an able and comprehensive report to the General Education Board of the Rockefeller Foundation, just issued from the press, Abraham Flexner now assures us that our medical schools compare very favorably with any others in the world. This report convinces us that, in the matter of medical education, we are in the very midst of an American Renaissance. I hope I do not claim too much in expressing a belief that our College has borne its share in this great reform. For the future we are fully convinced that our activities must always articulate with the work of our medical schools.

And this brings me naturally to a word or two that I shall say concerning the question of Research. No word in our language has been less accurately defined, or more grossly abused; indeed, it has almost come to represent a sort of fetish.

You will agree that the true spirit of Research reveals itself as an attitude of mind, and we remember that it is only this spirit that quickens and redeems. In his whole educational life, each man is inevitably his own Columbus, and must, of necessity, conduct his own exploration. In my judgment, thinking—hard, sane thinking—is a genuine investigation, and the critical application of one's thought to any problem constitutes a true "Research"—and this, not only in a laboratory, but in a hospital, or general practice. This attitude of mind, this critical, inquiring spirit, we may inculcate, for it lies within our reach; but the long history of medicine tells us that few men evince what Bastianelli calls, "the lightning flame of discovery." Through all these long

years, how few have been the men who have really added to our knowledge!

Unquestionably, our College must encourage this scientific spirit, this intellectual domination; for, by so much is the man uplifted and removed from mere routine. But at the same time, we strongly inveigh against a too-eager effort at mere "productiveness." There could be no worse disease than a rivalry in immature production—a travesty of Research; nothing could be more fatal to the institute or the hospital, the laboratory or the man.

The question of publicity, within or without the College, is a matter of general taste, and is, in consequence, of slow adjustment. It is, I grant, still a far cry to that Utopia where "each for the joy of the doing . . . shall paint the thing as he sees it, for the god of things as they are."

These are, very shortly, some of our domestic concerns; the concerns, may I remind you again, of our childhood. The problems here we will gradually solve and outgrow, to meet in their turn, the larger problems of our youth and maturity.

May I offer, as an adage for the coming years, the words of the late Sir William Dawson, who was so long president of McGill University. This is the adage: "Let us consider, not so much the petty difficulties which beset us, as the space for exertion which lies above them."

I conclude with a word of welcome to our new Fellows this evening. May their admission to fellowship prove an added strength to the College, and with equal truth, may the gates of a new life, a life of greater usefulness, be thrown open to them.

GENESIS AND PROGRESS OF THE AMERICAN COLLEGE OF SURGEONS[1]

By FRANKLIN H. MARTIN, M.D., F.A.C.S., Chicago

I. Foreword

MAY I ask the indulgence of the Fellows while I attempt to portray, chronologically, the beginnings and the progress of our organization? It will be necessary to relate some personal experiences, but it may be interesting to the students of history to have a record of our inception, some of the motives which impelled us and the manner in which our plans were brought to fruition.

A distinguished English surgeon who visited our country within a year recorded in his interesting travelogue that Surgery, Gynecology and Obstetrics was established by the American College of Surgeons; and recently I heard one of our prominent Fellows say that the College itself had been organized under the initiative of a certain society. I am personally interested to have these misconceptions corrected; and as I am the only one informed of many of the facts, it seems to me that it is my duty to present a correct record so that the real truth about these things may be known.

1904–1905

II. Surgery, Gynecology and Obstetrics

Making the academic practical

In 1904 the caldron of the old style journalism in medicine was boiling dry, and a new order of service, divorced from commercialism, was demanded. The *Journal of the American Medical Association*, which represented the democracy of the medical men of America, was shaking itself free of unworthy advertising and demonstrating that a medical journal, divorced from extraneous financing, published by the doctor for the doctor, would succeed, this under the able leadership of Dr. George H. Simmons, recently retired as editor of that journal.

The special medical journals, under the old financial and editorial dominations, were suffering from the milking of their exploiters, and were barely holding their own.

At this time the writer conceived the idea that if surgical specialists who were engaged in an active practice were to edit a journal of surgery and the specialties, such a journal would naturally contain the material that would appeal to other active specialists in surgery; if in addition to this the legitimate receipts from such an enterprise could be put back into the journal to make it more valuable to the profession, this too would enhance its usefulness and appeal to its supporters; and, finally, if such an enterprise could be conducted in a way that the mechanical makeup of the journal would appeal to the fastidious in literature and in artistic book-making, the result would be a surgical publication that would live. A journal edited by active surgeons for active surgeons was thus established. Its success professionally, scientifically, artistically, and financially, has made it the recognized leading surgical magazine of the world. The success of this experiment seemed to point to the fact that in the interest of progress, taskmasters should record their own accomplishments.

1912–1913

III. International Abstract of Surgery

In 1912–1913 the writer added to Surgery, Gynecology and Obstetrics the International Abstract of Surgery. This contemplated (and the plan has succeeded) furnishing each month to the specialists in surgery an accurately prepared abstract of the worthy surgical literature of all languages, and a complete bibliography of all current surgical literature. This was made authoritative and comprehensive by working arrangements with the recognized abstract journals of France and Germany, and by organizing a reliable staff of editors under our own supervision. Surgery, Gynecology and Obstetrics and the International Abstract of Surgery is subscribed for by thirteen thousand individual surgeons throughout the civilized world, and is to be found in all of the principal libraries where it is read by additional thousands.

These publications (which are the property of Mrs. Martin and myself, and which at the present time it is contemplated shall be bequeathed to the American College of Surgeons) have been successful financially as well as scientifically. The income of the Surgical Publishing Company represents a book value of one million dollars, and it has purchased and maintains its own quarters, immediately adjoining the College, in a property valued at three hundred thousand dollars.

[1]Report of the Director-General, presented at the Annual Meeting of the American College of Surgeons, New York, October 23, 1924.

1910

IV. The Clinical Congress of Surgeons of North America

"Show me" is more convincing than "tell me"

The passing of the proprietary medical journal and the proprietary medical school developed a protest among the surgeons against the exclusive *literary* conduct of our medical society meetings. We had learned by attending some of the leading clinics that greater inspiration was gained by watching a surgeon operate than in hearing him tell about it. Exclusive clinical societies of surgeons and gynecologists were organized, and in small groups they traveled far and near to watch their confrères at work in their operating rooms. This resulted in astonishing changes in the reputations of our society surgeons. The silent man of worth came into his own, while the loud man, accordingly, was found speaking in whispers. These exclusive societies became popular. Every surgical specialist and every man who was ambitious to become a surgical specialist, wanted to see the *real* surgeon operate, and had lost interest in the orations of the swivel-chair operator.

How could we satisfy this legitimate and worthy yearning? Surgery, Gynecology and Obstetrics had been established to serve the working surgeon. How could we supply this large and growing group of surgeons with the opportunities which were available to these small exclusive societies? We attempted a solution by asking the subscribers to Surgery, Gynecology and Obstetrics to attend the clinics of the surgeons of a great city. The result was epoch-making in the conduct of medical societies. Eleven hundred surgeons responded to that first informal invitation, and they were there and then organized into the Clinical Congress of Surgeons of North America, with a constitution, by-laws, and officers. Thus, informally in Chicago in 1910, and formally in Philadelphia in 1911 and in New York in 1912, were held the first meetings of the Clinical Congress. Was there a demand for such an organization? At the New York meeting in 1912 four thousand registered, and almost as many more attended who could not or did not register—more than the attendance at the meeting of the American Medical Association of that same year. Already our success had become so phenomenal that we were threatened with failure because of our inability to secure the admission of so many men to the clinics in any one city, or to find a hall large enough to accommodate them at a formal scientific meeting.

We met the immediate problem by announcing that in the future attendance at the Clinical Congress would be limited to the comfortable capacity of the city in which the meeting was to be held, and for this purpose we established advance registration "first come, first served." Preparations were also under way to meet the problem permanently, as will be told in the next section.

The Clinical Congress of Surgeons of North America, organized in 1910, functioned as an independent society until 1917, and held meetings in Chicago, Philadelphia, New York, London, and Boston. In 1917 it was amalgamated with the American College of Surgeons, and is now known as the Clinical Congress of the American College of Surgeons. It has a separate registration fee, it is self-sustaining, and only those who actually attend the meetings contribute to its support.

1913

V. The American College of Surgeons

Ideals made true in team-work lead to progress

The 1912 meeting of the Clinical Congress demonstrated what was foretold by the preceding two meetings, viz.: that their popularity would become their undoing if we did not adopt some plan to curtail the attendance. At the 1912 meeting, arbitrarily, a plan was initiated, as I have stated, to limit the attendance at future meetings.

The great appeal to the practical specialist in surgery of these clinical meetings made obvious the need for a great democratic society or guild of specialists. The diversity in the work of the clinicians at the various centers revealed the need for standards. The inferior work in some of the clinics demonstrated that no organized plan existed to protect patients against incompetent surgery. The hospitals in which the surgeons operated furnished a variety of facilities, ranging from bad or indifferent to adequate. There was no established authority of efficiency. The orgy of surgery coming into fashion had developed among the vicious a competition in fee-splitting, which led on to an organized traffic in the buying and selling of patients. It was a problem that was being discussed by all serious-minded surgeons. What could be done to put our house in order? The popularity of the Clinical Congress had revealed the fact that there was a demand for a democratic organization of surgeons, the proceedings of which should exhibit the art of surgery as displayed in the clinics; should promote research in surgical problems; should preserve inviolate the moral and ethical standards of the practice of surgery; should seek to maintain a high degree of

efficiency in the environment in which surgery is performed; and should list in some form that would be accessible to everyone the surgeons who would pledge themselves to conform to this program and who were adequately trained to do surgery. These were the unsolved problems which confronted us in November, 1912.

Having been responsible for the launching of the Clinical Congress, there was no one to whom these problems were brought home more forcibly than to the writer. Gradually the vision of a college or a guild of surgeons had been crystallizing, some organization that would correspond to the Royal Colleges of Surgeons of England, Scotland, and Ireland. An outline of such a plan was dictated by me to the public stenographer on the Twentieth Century Limited on my trip to the 1912 Clinical Congress. A resolution was formulated which provided for the appointment by the Congress of a committee of nine, with power to act, to organize an American College of Surgeons. The names of the surgeons who were to act on that committee were also recorded. On arriving in New York on the eve of the Congress the outline was presented to Dr. John B. Murphy for criticism. He went over it with great care. Instantly and enthusiastically he approved, and volunteered to support the plan. It was then submitted to Dr. Edward Martin, who was the president of the Clinical Congress, and discussed at considerable length. He, too, approved the project and the line-up of the committee. At the annual meeting of the Clinical Congress I presented the plan in detail and moved its adoption. Dr. Murphy promptly seconded the motion and supported it with a strong, enthusiastic speech. The resolution was adopted unanimously and the appointment of the following committee was authorized: Edward Martin of Philadelphia, Emmet Rixford of San Francisco, John B. Murphy of Chicago, Rudolph Matas of New Orleans, Albert J. Ochsner of Chicago, Charles H. Mayo of Rochester, Frederic J. Cotton of Boston, George Emerson Brewer of New York, John M. T. Finney of Baltimore, Walter W. Chipman of Montreal, George W. Crile of Cleveland, and Franklin H. Martin of Chicago. During the succeeding 6 months the writer, as one of the executive officers of this committee, visited all parts of the United States and Canada, and met groups of surgeons who were selected by the committee on consultation with local surgeons. The outstanding surgeons and surgical specialists in the states and provinces were invited to attend a meeting in Washington for the purpose of perfecting the organization of an American College of Surgeons.

On May 5, 1913, in the city of Washington, 450 surgeons attended such a meeting and the American College of Surgeons was launched. Meanwhile a charter had been secured.

With the president of the Royal College of Surgeons of England, Sir Rickman Godlee, as sponsor and godfather, and under the presidency of Dr. J. M. T. Finney of Baltimore, the first formal Convocation of the American College of Surgeons was held in Chicago on November 13, 1913, and 1059 United States and Canadian surgeons were admitted to charter membership.

1913

VI. Declaration against the Division of Fees

A flash of lightning reveals dark spots

A genius, backed by moral character, courage of his convictions and the spirit of a crusader, created a dramatic moment in the organization meeting of the College that more than any other incident has reflected its influence for good throughout our short career. I have reference to that respected dean of surgery in classic Indiana, Dr. Miles F. Porter, who rose in that first meeting and pleaded for a declaration against the division of fees, the paying of commissions for surgical work, the buying and selling of patients. This suggestion was instantly backed by Dr. William F. Metcalf of Detroit, the challenge accepted with enthusiasm by the 450 surgeons present, and a declaration against the division of fees launched as one of the cardinal principles of the American College of Surgeons.

This principle, then inculcated, was immediately made militant by the new Board of Regents. Two declarations against this abominable practice were immediately prepared: One, the pledge against fee-splitting that every applicant for fellowship is required to sign, popularly called the "battle-ax" pledge because of its relentlessness, of which Dr. A. J. Ochsner is the author, and the other, the Fellowship Pledge, prepared by the writer, which touches upon other amenities of good practice and good fellowship, and which also has a constructive declaration against unworthy financial transactions.

As a result of our stand in this matter for the past 12 years, this practice is frowned upon by all decent medical practitioners, and we have aided in placing upon the statutes of eight states of the United States anti-fee-splitting laws that have for their object the protection of the public against the practice.

1915

VII. Endowment and Dues

Dreams are interesting, but work and hard cash make them come true

In 1915, at the annual meeting of the Board of Regents, it became apparent to each member of that body that the College of Surgeons, by its profession of ideals, had assumed a great obligation, and in order to meet it, it would be necessary to show that it had the courage of its convictions, and to assume the responsibility of financing its own big program. Nothing would go further toward proving our dead-earnestness than to subscribe forthwith to a permanent endowment fund. Beginning with the Regents, 1000 of the three thousand Fellows then enrolled subscribed $500 each to this endowment. Since that time the major portion has been collected, and an additional amount has been added, making a present permanent endowment invested in trust securities of $622,000.

At a subsequent meeting of the College the Board of Regents was authorized to prescribe the amount of the annual dues of the Fellows, and they were fixed at $25 a year.

1915

VIII. Examination Requirement for Admission to the College

Fiction is interesting, a glib tongue at times entertaining, but an individual's worth is shown by the record of his work

In 1915 it became apparent that we should institute some form of test which would aid us in estimating the professional qualifications of our candidates for admission into the College. Already our requirements for admission were such that they had excited the admiration of the old established colleges of Europe. We required that a candidate should be recognized as a surgical specialist by his own confrères—that at least 85 per cent of his professional activities should be in his specialty; insisted that he should have been a graduate in medicine for a period of at least 7 years; required that he should make a solemn declaration against unworthy financial transactions, and that he should be vouched for by a strong committee of his neighboring practitioners as a desirable member of society. But this was deemed insufficient, and in addition a regulation was adopted requiring each applicant under forty years of age to submit to an examination committee a complete report of fifty major operations which he had himself performed, and an abstract report on fifty additional cases on which he had operated, or in which he had acted as an assistant. This test proved so successful in revealing the surgical qualifications of our applicants, as it eliminated more than 50 per cent of those otherwise acceptable, that in 1923 the same rule was extended to apply to all candidates who were not, because of some special distinction, otherwise received by a majority vote of the Regents.

This method of procedure proves a man's fitness to do actual surgery and is far superior to the ordinary written and quiz examination that proves only his theoretical knowledge of surgery; and it has, therefore, been the subject of favorable comment, and has elicited much praise from distinguished fellows of the European colleges of surgeons where the passing of an academic examination alone is accepted as evidence of a man's eligibility for fellowship.

1916–1917

IX. Standardization of Hospitals

Successful work is most easily accomplished in a proper environment

The examination of case records submitted by applicants within one year proved that many of the hospitals in which they were doing their surgical work were inadequately equipped. The records showed lack of system in recording cases; either there were no laboratory facilities or the laboratory was woefully deficient; medical staffs were unorganized, and team-work which makes for helpful consultation was almost entirely lacking. The necessary "turn-downs" of applicants on the case records coming from many such hospitals led to inquiries on the part of hospitals as to our requirements. Our replies led to a request that we furnish outline blank forms of records which we considered acceptable. This we did. We were then requested to suggest a standard for laboratories and for staff organization. It soon became apparent that we were having a grave responsibility thrust upon us. Mr. John G. Bowman, who was at that time director of the College, discussed the matter with me and we decided that the standardization of hospitals, because that was what it meant, would properly come under the supervision of the American Medical Association, at least so far as it applied to the United States. This suggestion was taken by Mr. Bowman to the chairman of the Committee on Medical Education of the American Medical Association, Dr. Bevan, who spoke of the expense of such an undertaking, of the fact that the subject had

been discussed by the Board of Trustees, and that they had decided not to accept the responsibility of such a task. He was then asked if there would be any objection to our doing the work, and the reply was in the negative.

This left the College not only free to undertake the project if it saw fit, but quite definitely thrust an important obligation upon its shoulders.

More than a year was given to the careful consideration of this whole problem, and in the meantime we aided the hospitals in improving their facilities by correspondence, conferences, and writings.

We had only started our work when a great hospital system had to be organized for the Great War by the Medical Corps of the Army, the Navy, and the Public Health Service. Several conferences on this subject were held in Washington, where we combined our experience in hospital organization with that of the war experts and other authorities, and helped the government to create a standard hospital system.

During the hectic years of 1917 and 1918, the hospital program of the College developed. In the latter part of 1917 and early 1918, several plans were outlined and rejected. Finally, while Mr. Bowman and I were considering this entire program one day, we decided that while we must always assume the attitude of advisers on this whole subject, the time had come for us to shoulder the responsibility of furnishing a definite standard to hospitals. Then arose the question as to whether our standard should specify the maximum or the minimum requirements for a hospital. To popularize our assumption of authority, and to make the plan workable, could we not accomplish more by a *minimum* standard which would contain the fundamental requirements essential in every institution for the care of the sick rather than a *maximum* standard which would necessarily be burdened with unessential details? This plan was freely discussed and in the revision we had the views of Dr. John Bresnahan, a practical hospital expert, who at that time was serving on our staff.

The minimum standard was decided upon. It should be simple and direct and cover not more than one sheet of paper. Mr. Bowman retired and within 24 hours returned with the first tentative outline of the text of the minimum standard for hospitals. This document has now achieved international fame and has become to hospital betterment what the sermon on the mount is to a great religion.

The 1,427 hospitals that are now on our accepted list, and that proudly acclaim our leadership, and the thousands of smaller hospitals that have accepted our principles and are aspiring to meet our ideals, testify to the transcendent importance of this program that we have originated, financed, and administered, and that has attracted the admiration and following of three continents.

This program was successful at its beginning because of the influence of the members of the College who were serving in the hospitals throughout the continent. Right-thinking medical men, whether members of the College or not, soon realized that our program represented an ideal that made for greater efficiency in hospitals. Finally, through our propaganda for better hospitals, the people, including hospital trustees, hospital superintendents, nurses, and of paramount importance the prospective patients, were impressed not only with the necessity of recognizing our standard, but with a religious enthusiasm to adopt it. All hospitals in large and small communities are now appealing to us for our stamp of approval. The hospital authorities realize that the people who support hospitals will soon demand that all institutions for the care of the sick meet this standard of efficiency or be read out of existence.

In the meantime the medical staffs, without regard to specialties, have recognized in our hospital program a great weapon against fee-splitting, inasmuch as each accepted hospital must produce a declaration, signed by each individual member of its staff, against this unsavory practice.

This movement for the betterment of hospitals has attracted toward its support all people and all organizations interested in hospital efficiency. The American Hospital Association, of which Dr. Malcolm T. MacEachern, one of our associate directors, is a past-president; the Catholic Hospital Association of which Reverend Charles B. Moulinier, S.J., is president; the Protestant Hospital Association; the Board of Hospitals and Homes of the Methodist Episcopal Church; and the Baptist Hospitals are enthusiastically supporting and applauding our program. The American Railway Association has requested its 14,000 surgeons to use our approved hospitals wherever available, and to standardize the hospitals under their immediate control. General Hines of the Veterans Bureau has asked us to survey the hospitals under his jurisdiction in order that the people may be assured that the institutions for the care of soldiers meet the requirements laid down for acceptable lay hospitals. The same is true of the Marine Hospitals, and Surgeon General Cumming of the Public Health Service has asked for our survey. The movement has met

the approval of the great philanthropic foundations, the Carnegie Corporation having financed our activities to the extent of $105,000.

1916–1917

X. Organization for the Great War

When one's house is in order he is prepared for storm

When it became apparent that the war storm in Europe could not be stayed without the aid of this country, and the United States set about its preparation, it was the American College of Surgeons that first responded in preparing the medical facilities for war activities. Early in 1916 one of our Regents, Dr. Frank F. Simpson, rallied the medical profession to action. All organized medicine was invited. The Association of American Physicians for Medical Preparedness was organized, under the supervision of a Committee of 28, which, in addition to the three Surgeons-General, included a group of civilian physicians and surgeons who on invitation accepted the call to aid in preparation for war. Of those accepting this invitation the majority were members of the American College of Surgeons. In April, 1916, one year before war was declared, representatives of this Committee took counsel with President Wilson, and the Committee as a whole was recognized by the War and Navy Departments as a desirable aid in preparing the medical profession for co-operation and enrollment. General Gorgas, early in 1916, issued invitations to the Fellows of the American College of Surgeons to join the Medical Reserve Corps. The American Red Cross, under Colonel Jefferson R. Kean, at Dr. Simpson's suggestion and at the request of Secretary of War, Baker, asked Dr. George W. Crile, in charge of the Lakeside Hospital Unit of Cleveland, to mobilize in Fairmont Park, Philadelphia, at the November, 1916, meeting of the Clinical Congress of the American College of Surgeons. This was done and it initiated the first real demonstration of what was to come, and was of great value in stimulating the organization of the forty-two great Base Hospitals representing our various university and hospital centers.

In the summer of 1916, Dr. Simpson called a number of his committees to Washington to urge upon the Secretary of War the advisability of including a medical representative on the Advisory Commission of the Council of National Defense. This appeal was met and the law was so written. When later an official of the American College of Surgeons was appointed to this position by President Wilson, the Association for Medical Preparedness was taken over and formed the nucleus of the Section of Medicine and Sanitation in the Council of National Defense.

When our entrance into the war appeared inevitable and it was found desirable to organize the General Medical Board of the Council of National Defense, Secretary of War Baker, at my suggestion, appointed to this Board many of those who responded to our informal invitation of the previous year. Over 90 per cent of the Fellows of the College who were of military age donned the uniform of the Army or Navy. Those who were ineligible for military service sought other means of serving their government.

President Wilson was so impressed by the patriotic response that was shown by the medical profession, and by this organization in particular, that he wrote a very flattering letter of appreciation to the Chairman of the General Medical Board, in which he asked that his thanks be extended to the medical profession that had so generously rallied to his support.

1915–1919

XI. Permanent Home

From the beginning a controversy was waged in regard to the permanent home of the American College of Surgeons. At the Washington meeting of the College in 1915 a committee, appointed to consider this subject, reported in favor of Washington as the permanent home. The matter was discussed at some length. As the Committee made no suggestions as to ways and means of establishing a home, and as there was a strong sentiment in favor of a home situated more nearly in the population center of the country, a definite vote was not registered. In 1916, our distinguished founder, Dr. Murphy, died, and his Chicago lay and professional friends set about to do him honor. It occurred to them that nothing could be more fitting than to establish a monument to him in the form of a site and much needed permanent home for the College of Surgeons in the city in which he had worked and lent honor as a master surgeon. There was a fair prospect that this would be carried out promptly and that a site would be furnished in a public park of Chicago. The Fellows of the College were asked through correspondence to indicate their preference, and their replies indicated that they favored accepting this offer if a site in Chicago were proffered on the basis of a gift. The war, and the sudden death of the two principal promoters of the plan, led to a postponement of its execution.

In June, 1919, under the presidency of Dr. W. J. Mayo, the Regents gave Chicago 2 months in

which to fulfill its promise of a site that would meet the approval of that Board. In less than the prescribed time the present home of the College was purchased by the lay friends and the Fellows of the College residing in Chicago and formally presented to the College without cost. This not only provided the required site, centrally and conveniently located, but in addition a commodious and beautiful building adapted to the administrative work of the institution.

At this time, too, was revived a movement to build a monument to Dr. Murphy, this to be in the form of a building to house suitable assembly halls, the library and the museum of the American College of Surgeons. A donation of $100,000 by Mrs. Murphy was promised as a nucleus of a fund of $500,000. The lay friends subscribed $200,000 of the remaining $400,000. The balance, $200,000, as you know was pledged in individual voluntary subscriptions by the Fellows of the College. The Murphy Memorial Building, specially designed for our use, will present when finished a most dignified and beautiful structure. It will be ready for occupancy March 1, 1925.

This will complete a beautiful home that will be adequate for our needs for many years to come. It is within five minutes' walk of the center of the second city on our continent, and the third city in the world, and within 200 miles of the center of population of North America. It was given to the College of Surgeons without one cent of cost to the corporation. Its actual cost to the donors was $600,000. Conservatively estimated, the present value of the land alone, due to the rapid increase in values since the purchase, is $750,000, and the buildings, including the new Murphy Memorial, at least as much more, or a total value of more than $1,500,000.

1919

XII. Sectional Meetings

Decentralization leads to saturation

It is estimated that more than one-half of the Fellows of the College would attend the annual Clinical Congress if our attendance were not limited. We are aware that on our continent surgery of the highest quality is being performed in cities of from 10,000 to 200,000 inhabitants. In each of these cities reside Fellows of our College.

In 1919, under the presidency of Dr. W. J. Mayo, a plan was presented for approval to groups of Fellows in the different States and Provinces which provided for the conduct of miniature Clinical Congresses as state or sectional meetings, these meetings to consist, first, of clinics at which Fellows of the College in the city in which the meeting is held would operate; second, dry clinics and practical papers conducted or read by invited guests and Fellows of the College; third, a hospital conference to which all hospital administrators in the States and Provinces included in the section would be invited; and, fourth, an evening meeting for the lay public, addressed by officials of the College, distinguished guests and local celebrities, a meeting at which personal health problems would be discussed.

The idea for these sectional meetings was presented to me in correspondence by that enthusiastic Fellow of our guild from North Carolina, Dr. John Wesley Long, and one of the first individual tryouts of the plan, which was enthusiastically embraced, was in his state of North Carolina. The first series of these meetings was held in the North-West States and British Columbia, and they were a great success from the first. However, the scheme was a new one and one of its innovations involved a frank talk by doctors to laymen and women. There was a furore of opposition on the part of a few conservatives, and some attempt to discourage the execution of our program by organized opposition. But the success of the venture soon became apparent. The attendance at the meetings of the second year was about double that of the first; and during the third year the attendance increased proportionally. The meetings held during the fiscal year just past have filled the largest auditoriums we could secure; and now, like the Packard Motor cars, they are the most imitated vehicles within the jurisdiction of the College.

These meetings have been of the greatest help in making known the ideals and constructive work of the College. Gradually the public has become cognizant of a great movement for hospital betterment; gradually the public has become aware that scientific medicine is something real; and gradually the public has come to realize that the modern doctor is not a man of mystery, but a human being and a public benefactor; and of even greater importance, the public has been told in an understandable manner the story of the abomination of fee-splitting and of crooked medicine.

1921

XIII. Literary Research

The practical worker "sufficient unto himself" is dead, while "give and take" among fellows leads to progress and life

Great universities, great philanthropic foundations and individuals of great wealth have in-

vested vast sums in support of scientific research. It would be unwise and unnecessary for our College to attempt to duplicate such research. However, our policy "the practical surgeon for the surgeon" beckons us to a field in research all our own, unlimited in extent, unappropriated, easily within our means, and of inestimable value to clinical medicine. Some of the problems which the College has adopted as its legitimate field of work are:

1. RESEARCH OF LITERATURE

Our Literary Research Department is making available to clinicians an organized and authoritative means of obtaining through trained workers what they desire in medical literature—either in the form of an abstract, of a bibliography, or of extensive research of the literature in all languages. Service of this type, accessible to all clinicians, takes that important work out of the hands of unorganized commercial individuals, or unsatisfactorily financed organizations, and offers reliable, censored service at less than actual cost; and the expense is gradually diminishing because of our ability, through proper organization, to accumulate valuable material. This department was instituted in 1921, and has already furnished to hundreds of clinicians assistance of inestimable value.

2. REGISTRY OF BONE SARCOMA

This study, which has been the subject of discussion in special surgical gatherings for years, needed to be taken under the wing of some organization that could publish its literature and finance its correspondence. Those vitally interested selected as the leader in this study and as the champion of their propaganda, Dr. Ernest Amory Codman of Boston. The College accepted the responsibility of giving it shelter, and the modest support it required.

3. CLINICAL RESEARCH IN THE TREATMENT OF MALIGNANT DISEASES BY RADIUM AND X-RAY

This survey was initiated in 1921, with Dr. Robert B. Greenough, of Boston, as chairman. No organization was in a better position to back this practical investigation than the American College of Surgeons, with its more than 6,500 surgical specialists. The importance of this research will become more and more apparent as time goes on, and the evidence of five-year cures is accumulated in the yearly reports. These reports will be carefully analyzed and valuable conclusions deducted to guide the clinicians in the treatment of this formidable malady.

4. TREATMENT OF FRACTURES

In 1922, under the guidance of Dr. Charles L. Scudder of Boston, the study of a standard for the treatment of long-bone fractures was initiated. It was recognized that the minimum standard for hospitals would have to be amplified from time to time by the addition of suggestions for a standard of efficiency in the specialties of surgery. Much valuable material in the treatment of fractures had been assembled during the war. Standardized apparatus has been evolved, and material accumulated for a still further stabilization of this chaotic subject. Dr. Scudder has organized a committee that is already bringing about order, and the findings, which represent the consensus of opinion of men of experience, have been passed along to clinicians and hospitals for their consideration and adoption. This committee will continue its work and make its yearly report and recommendations through the College and its publications.

5. STANDARDIZATION OF CLINICAL LABORATORIES

The question was often asked: "What kind of a clinical laboratory, which will not entail prohibitive expense, do you recommend as acceptable to your hospital survey department?" In 1922, a committee of eminent laboratory technicians accepted for the College the responsibility of attempting to consider this question. The committee consists of Dr. Francis Carter Wood of New York, Rear Admiral Edgar R. Stitt of the U. S. Navy, Dr. Ludvig Hektoen of Chicago, Dr. Louis B. Wilson of Rochester, Minnesota, and Dr. M. J. Rosenau of Boston.

These five activities are under way, and the College includes in its budget provision for defraying the expense involved in their clerical and other office work.

1920

XIV. INTER-AMERICAN AFFILIATION

Go into all the world and preach the gospel of co-operation among surgeons

Visits to South and Central America, planned at the beginning as a vacation trip, developed into an international adventure that involved the establishment of an intimate professional friendship between the surgeons of Canada and the United States, and the surgeons of all of the republics of Central and South America. It attracted the attention of the officials of our several countries, and it has become one of the political

ties that will bind us closer together as nations and make more harmonious our civilization. It will make for mutual appreciation of our educational methods, and will lead to interchange of teachers and students. It has already led to a federation of our specialists and surgeons in a College of Surgeons which is continent wide. We have made true the proverb that "in science there is no international boundary."

This movement was initiated in 1920 by our then president, Dr. W. J. Mayo, and your Director-General when we visited Panama, Peru, Chile, Argentina and Uruguay. Our reception was so cordial, and the desire on the part of our neighbors to co-operate was so manifestly genuine, that the visit was repeated the next year and extended to Brazil, Ecuador, and Bolivia. In 1923, the visit to the continent of republics was practically completed by adding Colombia and Venezuela and several of the Central American Republics to the list. This contact has seemed so important to the Board of Regents that they have cultivated it, and we now have in the South and Central America 198 members of the College, and in each of the countries a strong Committee on Credentials has been organized.

1924

XV. Australia and New Zealand

During the early months of this year, Dr. W. J. Mayo and your Director-General, entirely independent of instructions from the College, undertook a most delightful vacation trip to Australia and New Zealand. What at first was intended as a purely personal contact with the profession of these two interesting countries developed into a series of meetings and conferences at which we were asked to discuss the program of the American College of Surgeons, and especially its activities in hospital betterment. The fame of our College had preceded us, as the story printed monthly in our official organ had been carefully read by the more than four hundred surgeons in Australia and New Zealand who subscribe to the Journal. The story had appealed to these far-away neighbors of ours, and they were keen to obtain first-hand information about the working out of its details so far as they might be applicable to their own peculiar problems. We were careful not to make any tender of affiliation between our organization and theirs, although much thought evidently had been given by their surgeons to plans for the organization of a guild of surgical specialists which would do for them what the American College of Surgeons has attempted to do and is doing for Canada and the United States. Finally it was suggested that there could be no possible occasion for embarrassment if such of the individual surgeons of those countries as desired were to apply for fellowship in our College. A small group, as individuals, expressed the wish to do this. After our return, at the first meeting of the Board of Regents, this subject was discussed and a resolution adopted that will admit a selected group on a charter membership basis.

This visit was an inspiration to us and the strong friendships we formed as individuals were most gratifying. In this vacation, in this interchange of ideas, in this intimate way of exchanging viewpoints, we were taught how far apart we have been as neighbors, and how inevitably circumstances are drawing us nearer together. What a strong bond for scientific unity surrounds the Great Pacific, with South America, Canada, New Zealand, Australia, the Philippines, and the United States forming a great Pan-Pacific alliance cemented by scientific aspirations—an alliance that may bring us closer together in our national aspirations!

1923–1924

XVI. Judiciary Committees

Hold fast to that which is good, and cast out that which is evil

The best of plans will occasionally miscarry. In spite of careful references, in spite of careful Credentials Committees, in spite of ironbound declarations, in spite of our requirement, including the filing of case records that must be verified, and in spite of scrupulous care on the part of your Board of Regents, men have been admitted to fellowship in the College who should not have been accepted, as is occasionally true in our most exclusive clubs. Complaints are filed against these men and complaints are also filed against many men who are our most worthy Fellows. This is one of the most difficult problems that the Regents have been asked to solve.

In 1923, a welcome suggestion came from two widely separated sources: One from the Executive Committee of the Indiana State Section and the other from the Credentials Committee of Brooklyn. Each of these bodies asked that the appointment of a judiciary committee be authorized in every important community; that all comments pertaining to personal ethics of our Fellows should be submitted to a judiciary committee; that the individual Fellow involved should be asked to appear before such a committee and explain his conduct, the Judiciary Committee in

turn to present its report of the investigation, together with its recommendations, to the Board of Regents.

This plan has been approved by the Regents, and already a Judiciary Committee has been authorized in most of the states and provinces. The mere knowledge of the existence of such a committee, with power to investigate and make recommendations, has a very salutary effect in regulating local situations, and as the plan becomes operative, it will enable us to act intelligently in dealing with undesirable Fellows, or situations involving candidates or institutions.

1923–1924

XVII. The Junior Candidate Group

Train up a child in the way he should go, and when he is old, he will not depart from it

For a number of years it had been recognized by the Regents of the College that there was no provision for imparting our ideals to the young prospective surgeon. We had nothing to guide him during those 7 formative years—through his interneship, his assistantship, his early years while establishing professional and hospital alliances, dating from his graduation to the time of his eligibility for fellowship in the College. Some sort of affiliation seemed desirable. Practically every year it was discussed by us, but as no concrete plan, free from objectionable features, was presented, definite action was postponed from time to time. Finally, the idea was brought forcefully to the attention of the Regents by Dr. John Wesley Long, of North Carolina, at the annual meeting in 1923, and again at the Executive Committee meeting of the Regents at White Sulphur Springs last December. Dr. Long presented a comprehensive plan which he termed the "Candidate School" of the American College of Surgeons, and supported with a most convincing argument. A lengthy discussion ensued, modifications were suggested and finally the plan was placed in the hands of a committee of the Regents to formulate into a working project. The Executive Committee of the Regents, at the time of Dr. Long's presentation, expressed its great appreciation of his initiative in this movement, and further declared its belief in it by making his plan the basis of the organization of the Junior Candidate Group.

In establishing a Junior Candidate Group of prospective Fellows of the College, it is proposed that these candidates shall be accepted and placed on a probationary list as early as 2 years after graduation with the understanding that they be acceptable as Fellows not earlier than 7 years after graduation and that they then be subjected to the present requirement which necessitates the filing of one hundred case records as evidence of professional qualifications; also that they shall at the beginning of their candidature fill out and sign the same application blank, together with the anti-fee-splitting pledge, as is required of all Fellows of the College.

These young men will be kept in close touch with the activities of the College through our printed bulletins, and through the privilege of attendance at our sectional and state meetings. The College will have surveillance over these young men by requiring them to file annually, on carefully prepared blanks to be provided by the College, a summary of their activities for each year of the probationary period. These records will become a part of the credential history of the candidate, and will have a bearing upon his acceptance later as a Fellow of the College.

This plan forges another strong link in our propaganda against unworthy financial practices, and promises to make the work of our state and central Committees on Credentials more satisfactory and more accurate. It furnishes the young surgeon a tie of great importance in the formative days of his career, and harks back to the days when the student of medicine began his study under a preceptor. Why should not some Fellow of the College act as a preceptor, guide, and sponsor for each of our Junior Candidates?

XVIII. Summary of Administrative Achievements

Durable keystones of the foundation arch are essential

In every organization that is stable, key-men and women who are enthusiastic, resourceful, industrious, and above all loyal, must stand at the stress-points, carry the loads, and make well-thought-out plans come true. Such individuals have been in important departments of the College and of the Journal since their organization.

Dr. Allen B. Kanavel, the associate editor of Surgery, Gynecology and Obstetrics, was the first one to red-pencil the articles that were placed to the credit of the parent of the progressive organization. He has not only been the editorial censor, but with his judicial mind, he has been the stabilizer in the development of the Clinical Congress and of the College.

Mr. A. D. Ballou, the general manager of the Surgical Publishing Company, naturally became

the general manager of the Clinical Congress. He issued the first program in 1910, as he will issue the last program in this present Congress; and his faithful organization will issue the last ticket. Faithfulness, industry, tactfulness, and loyalty to his trust are his credentials. His business sagacity, and his knowledge of the intricacies of printing and publishing, are unsurpassed. The progressive work of the Journal and of the Clinical Congress is his pride!

Mrs. Marion Farrow, the business manager of the offices of the College, has developed in our ranks. She is a leader of the forceful type, and faithfulness to her trust is her religion. Business methods of the most efficient kind are essential to the success of a great commercial enterprise; and they are none too good for an academic venture. Her associates are inspired by her devotion to our cause, and the *esprit de corps* of her office spells enthusiasm for the College, and industry in the development of its program.

At all times each one of the personnel of our organization has been carefully selected for his ability to do a definite task, and for his willingness to accomplish that task with all of his might. Everyone on the payroll of the College is proud of his institution and your institution, and considers it a privilege to be one of its laborers.

And at a critical time came another keystone, in the person of Mr. Walter E. Carr, that was necessary to sustain another beautiful arch in our structure. Like a father, he has nursed with devoted hands our monument to Dr. John B. Murphy. When that structure goes down into history, those who were near at the time of its building will remember this devoted friend who was so much interested in its development and whose very soul has become a part of its masonry.

From the beginning there have been those who, disinterestedly, have worked for the success of our ideals. They have done it at a great personal sacrifice of time, and always they have refused to allow their trust to become marred by the practice of expediencies or politics. Nowhere has statesmanship been more manifest. I refer to the members of the Board of Regents who, year after year, have served the College since its organization. As is true in great universities, we seek stability by retaining the faithful trustees as long as their services are available, and they accept the responsibility of regular service. Their names are: Finney, Chipman, Matas, Ochsner, Crile, Mayo, Kahlke, Armstrong. These men served us at the beginning and they are with us now. Another group which joined us later is faithfully serving us with these pioneers.

Visions, plans and organization in any worth-while enterprise are important; but wise administration is essential

In this too long address I have merely touched upon the outstanding activities of our institution. The conception, the planning, and the organization are important, but things just thought of and started do not become working realities without proper guidance. Thousands of details must be planned, thousands of hours of work must be organized, and thousands of hands must be employed in the mechanical task of guiding successfully through its first two decades of life an institution of the importance of ours.

That the College has been successful is not only evidenced by its history, the salient points of which have been enumerated, but by its reputation for doing useful things and by the appeal it has made to the working and thinking clinicians of three continents who have become a part of it; also by the fame it has achieved with surgeons of ability in the other countries of the world.

From the beginning, its strong Board of Regents has been of one accord—that the institution should not only fulfill its obligation as a great educational guild, in its support of working surgeons, but that its financial conduct should be on the most approved business basis. Evidence that this has been accomplished can be best set forth by the facts. From its beginning it has planned to pay its own bills; it has supported a definite progressive program of standardization, not only of the activities of surgeons, but of the environments in which surgery is performed; it has stood for and fought for ideals; and the expenditures have been rational but continuous, from our small beginning of a budget of twenty thousand dollars a year, to the present budget of $150,000 a year. We have been aided in our hospital work by gifts from the Carnegie Corporation to the extent of $105,000, spread over several years. With this considerable expenditure we have been careful to prepare for the future, and to place your organization beyond the possibility of ever having it become a "hand to mouth" proposition. You have placed in its vaults $637,000 of gilt-edged securities, the principal of which is to be held in perpetuity. These securities are invested in government and municipal bonds, and net an interest of a shade more than 5 per cent. Your institution is housed in a beautiful administrative home, on a site of increasing value, given to you by the citizens of a great city. Your accumulated assets in securities, valuable ground and buildings, aggregate on a conservative basis $2,000,000.

The administration of this property and the expenditure of the income of the College in its important activities is accepted as a serious responsibility by your Regents. The expenditures are based on a budget system, and this in turn is based upon the income for the previous year, with a provision for a substantial margin of saving which is immediately added to the endowment fund. The budget is based on the estimated expenditures of the various departments, i.e., the hospital department, department of state meetings, the literary research department, etc., and a definite sum is appropriated for each. Each month the head of each department receives a statement from the Accounting Department of his appropriation, the amount of his current month's expenditures, and the balance of the unexpended appropriation. No department is allowed to exceed the appropriation for a given period.